SCIENTIFIC AMERICAN

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[5 CENTS A COPY
$3.00 A YEAR.

Cylinders, 22 inches by 28 inches. **Driving wheels,** 80 inches. **Weight on driving wheels,** 145,000 pounds. **Total weight of engine,** 221,200 pounds. **Weight of engine and tender,** 367,200 pounds. **Heating surface,** 3,436 square feet. **Drawbar pull,** 28,708 pounds. **Built for fast passenger service of the Chicago and Alton Railroad.**

HUGE PROPORTIONS OF THE MODERN EXPRESS LOCOMOTIVE.—[See page 402.]

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NEW YORK, SATURDAY, MAY 20, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE RECENT RAILROAD HORROR.

The shocking railroad disaster near Harrisburg on the Pennsylvania Railroad lines is strangely like the still more fatal accident that occurred on the allied lines of the same system, when over half a hundred lives were lost. In each case the wreck of the passenger train was caused by a freight train on the adjoining tracks. In the accident of over a year ago the loss of life was due to careless loading of timber on a flat car, the material being insufficiently secured against lateral displacement due to the jolting and lurching effects in passing around the curves. Some timbers were displaced and struck the cars of the passenger train, precipitating the disaster. In the present case, the wreck was caused by the buckling or crumpling up of a long freight train, to which the brakes were being suddenly applied to prevent a collision between the freight train and a switching engine. The buckling of the train threw the cars against the express, wrecking the train and causing the detonation of some high explosives that were on the derailed freight cars. Much of the horror of the accident, which involved the death of over twenty people, and the injury of probably a hundred others, was heightened by the frightful explosions and the subsequent burning of the wreckage which contained many of the imprisoned passengers. The marvel of the wreck is not that so many, but so few, were killed.

We wish to draw attention to the fact that this catastrophe shows, in a most dramatic way, what a great peril the passenger trains on four-track railroads are exposed to in having to sweep past the whole length of the many 40- and 50-car freight trains, which they meet so frequently in traveling through busy manufacturing districts such as those traversed by the Pennsylvania Railroad. It is a fact well understood by railroad men that the enormous length to which freight trains have grown of late years exposes them to exactly the kind of accident which caused the recent disaster, namely, the crumpling up of the train when the brakes are suddenly applied if the action of the brakes is not uniform throughout the whole length of the train. If a freight train of 40 or 50 cars and weighing over 2,000 tons is traveling say at 20 miles an hour, and the air brakes are applied and act simultaneously and with equal efficiency on every car, the whole train would be brought to rest without any danger of crushing or displacing the cars. But if the action of the brakes should be faulty, and the brakes should be set hard on say only the first half or third of the train, the enormous momentum of the last half or two-thirds, expending itself on the portion upon which the brakes are in full action, brings a crushing strain which the cars are unable to withstand, and they are forced into one another or twisted from the track and thrown sidewise onto the adjoining tracks. It is well known among railroad men that accidents of this kind are extremely frequent, and that they constitute a standing menace to fast trains on the adjoining passenger tracks—a menace that cannot be safeguarded by signals, not, at least, if the wreck should take place when the express is within a short distance of or passing the freight train. This is one of the perils to which the recent rapid growth of freight traffic, and the endeavor to cheapen its transportation by using enormous engines and trains of exaggerated length, have brought us. The only safeguard against it is the exercise of eternal vigilance on the part of the engineers of passenger trains, and the most careful use of the air brakes on the part of the engineers of long and heavy freight trains.

TWO GREAT OCEAN CONTESTS.

The eyes of the world just now are fixed with fascinated interest upon two great contests on the high seas, the like of which the world surely has never witnessed before. In each case the prize is a big one, and its possession means so much to the contestants, that every nerve will be strained to the utmost for its coveted possession. It is in this element of keen rivalry alone, however, that the two great struggles have anything in common. Outside of that they are as far asunder as love and hate, exhilarating life and bitter death.

On the Atlantic eleven noble yachts are speeding to the eastward as fast as swelling canvas and straining sheets can drive them. The prize is the greatest that can be offered in our noblest field of sport; for the winning flag will represent, beyond dispute, the supremacy of yachting on the high seas.

On the Pacific, two mighty armadas are engaged in a life-and-death struggle, the like of which, we may say again, has never been witnessed in the history of the world. Two hundred modern ships of war, embodying, among them, the very latest constructive skill of the naval architect, and, on one side at least, the highest professional skill and leadership of the officers and daring and devotion of the crews, are moving to meet in the shock of a struggle, the prize of which is an empire of fabulous wealth and untold possibilities.

Is there not something of encouragement and sincere gratification to be found in the fact that at this hour a peaceful struggle between less than a dozen yachts for a golden cup should so completely have absorbed the interest of the public as to make them lose sight, for the moment, of the stupendous conflict impending in far eastern waters?

Of the yachting contest, we have spoken at some length on another page. In forecasting the possible outcome of the great struggle between the fleets under Togo and Rojestvensky, we must be careful to bear in mind that any mere tabular statement of the material contained in the opposing fleets may be very misleading. Before we can judge the actual fighting strength, we must know something of the quality of the material, its age, and its efficiency—considerations which might easily change a balance which seemed to be in favor of one fleet until it became a balance entirely in favor of the other. To make clear our meaning, let us take the case of the total number of heavy armor-piercing guns carried by each fleet. One might say, remembering that the battles of the war have been fought at long range, that only guns of 9, 10, and 12-inch caliber should be reckoned as effective in a fight between armored vessels capable of standing in the front line of battle, and that only heavily-armored ships of the battleship and coast-defense type should be included. Judged on this basis, and disregarding any other considerations, Rojestvensky would appear to have a sufficient preponderance of gun fire to absolutely crush Admiral Togo and sweep him from the eastern seas. Now that Admiral Nebogatoff has effected a junction with the Baltic fleet, Rojestvensky can theoretically put into the front line of battle eight battleships and three coast-defense vessels, carrying between them a total of forty-five heavy armor-piercing guns of from 9 to 12-inch caliber, and of these twenty-six are 12-inch guns. Against these Admiral Togo could put in the first line only five battleships, carrying twenty 12-inch guns.

When we come to look into details, however, we find that although the Japanese have a numerical inferiority so great, their ships are all modern, and their guns of high velocity. Among the Russian battleships three, at least, are so old and their heavy guns are of such short length and low velocity, that they must be reckoned as distinctly of the second class; while one of them, that is protected with compound armor, must be reckoned as almost obsolete. Furthermore, the 9-inch guns are of such low velocity and limited carrying power that they have less penetration by fully thirty per cent than the 8-inch guns carried by the Japanese armored cruisers. If these older battleships are fit to fight in the first line of battle, so surely are the eight armored cruisers of the Japanese, with their high-velocity 8-inch guns, of which they mount thirty-two altogether, and their 7-inch face-hardened armor, which is probably as effective at long ranges in bursting and breaking up armor-piercing shells as the soft, compound armor carried by at least one of the Russian battleships. Add to these facts that the Japanese have an overwhelming superiority in light cruisers, scouts, and torpedo boats; that they are fighting in or near their home waters; and that the Russian fleet depends for coal upon colliers that are liable to capture when once the fleet has passed into Japanese waters, and it will be seen that the total advantage does not by any means lie with the Russian fleet, powerful though it be.

COMPLETE THE COAST DEFENSES.

On January 16, 1886, the Endicott Board of the army outlined a system of sea-coast defense for the adequate protection of our seaboard. During the past nine years work has been done on the emplacements and the guns as fast as appropriations by Congress would allow. Up to date $110,000,000 has been expended; and it is estimated that it will take $65,000,000 more to complete the work. The guns already emplaced include ninety-three 12-inch, one hundred and nineteen 10-inch, ninety-three 8-inch, three hundred and fifty 12-inch mortars, and one hundred and eighty-five rapid-fire guns. This means that eighty-three per cent of the heavy guns, sixty-six per cent of the 12-inch mortars, and fourteen per cent of the rapid-fire guns required for our coast fortifications are already mounted. So far, so good.

Unfortunately, as matters now stand, the value of this fine equipment is reduced by about sixty-six per cent, because it is not provided, or is very ill-provided, with the range-finding apparatus which is necessary to the efficiency of a modern long-range battery.

Unless big guns of 10 and 12-inch caliber be provided with accurate range-finders, they cannot make good shooting beyond ranges of two miles; but with accurate range-finders, these guns are effective against the enemy up to an extreme range of six miles, and the smaller caliber guns at proportionately decreasing distances. The ineffective work done by the heavy guns at Port Arthur against the Japanese fleet has been a matter of general comment, and the following explanation has been given by the Russian general of artillery, Martushev: "The remarkable action of the Quantoon fortress artillery," at Port Arthur, "as manifested during the repulses of the Japanese fleet, leaves nothing to wish for in what concerns the shooting at middle or short ranges. But when the ranges are 10,000 or 12,000 meters, this artillery does not shoot at all, or fires without results. If it were otherwise, it could never have happened that the bombardments at Port Arthur, lasting sometimes several hours without interruption, were without results, when under the circumstances every minute ought to have caused the loss of some ship, small or big."

Brigadier-General J. P. Story, chief of artillery, U. S. A., states in his last report that it would be impossible, if the position-finding equipment were completely installed on our fortifications, for hostile vessels to remain at 10,000 or 12,000 meters from our batteries of 12-inch guns or mortars for two or three hours, and not be destroyed. He then proceeds to make the following astounding statement: *"I regret, however, to have to say that even at this date most of our fortified harbors are no better supplied with position-finding equipment than apparently is Port Arthur."*

Evidently some of the amazement which we have been expressing at the apparent lack of preparedness of the Russian authorities, displayed at Port Arthur, may well be reserved for the extraordinary condition of things thus revealed in our own defenses.

In its annual report of 1903, the Board of Ordnance and Fortification recommended that $2,000,000 be appropriated each year for the next few years, for range-finders and other instruments for fire control, etc., and stated that it was aware of no object for which sums of money could be more effectively expended, or from which greater benefit would be derived. In its annual report for 1904 the Board made the further statement that, in the present state of coast defense, money can be more advantageously expended for fire control than for any other permanent installation.

It has been a characteristic of modern military inventions during the past few years, that several small and comparatively inexpensive devices have been produced which enormously increased the effective value of heavy and costly war material. We may mention the soft cap for armor-piercing projectiles, the telescopic sight, and the modern position or range finder, now under discussion. So great is the influence of such inventions, that their possession by one of two contending forces might easily determine the fortunes of a battle, or even of a whole campaign. As one illustration of this, we may mention that in the naval battle of August 10, the Japanese did and the Russians did not carry telescopic sights on their guns—a difference which in itself was quite sufficient to determine the issue of that fight.

We commend these facts to the careful consideration of Congress, to whom it must surely be evident that no appropriation could be granted to better effect than the annual $2,000,000 necessary to render our present costly coast defenses fully efficient.

THE INTERNATIONAL RAILWAY CONGRESS.

Although the International Railway Congress in Washington was primarily a gathering of the foremost railroad men of the world for the discussion of the technical and commercial side of the great subject of railway transportation, the exposition of American railway appliances, which was held on the grounds adjoining the Washington Monument, played a most important part in connection with the great international gathering. Although it was understood that the foreign delegates would travel widely in the United States before returning to their various and widely-scattered homes, and would, therefore, have the opportunity to become acquainted with the American railroad in its active operation, it was realized that the limited time at their disposal would prevent many of them from obtaining as intimate a view of our railway plant and appliances as they might wish to secure. Hence the suggestion, which soon took practical shape, to hold an exposition of railway material at Washing-

ton, and erect buildings and set apart grounds of sufficient area and size to contain a complete exhibit of American railway plans and appliances. This was practically the first exclusive exhibition of its kind ever held, and, apart from the main exhibition building, there were several buildings erected by the largest and most widely known manufacturing firms who deal exclusively with railway material. The exhibition fulfilled its purpose of bringing the railway delegates in touch with the latest improvements, and as these are the men upon whose word the adoption of new plants and the placing of large orders really depends, it is believed that the exposition will have an important effect in increasing the exports of American-made railway supplies and material.

The questions that came up for discussion at the Congress were grouped in five main sections, as follows: First, Ways and Works; second, Locomotives and Rolling Stock; third, Working; fourth, General; and fifth, Light Railways. Under the head of Ways and Work there were four sub-sections, the first of which dealt with wooden sleepers or cross-ties, and was concerned with a study of the selection of kinds of wood and also a study of the processes of preservation of railway sleepers or ties. Then followed articles and a discussion of Rails for Lines with Fast Trains, in which the question of cross-sections of heavier rails, the best metal for rails and ties, rail joints, suspended joints, and supported joints were gone into at great length. The third sub-section was concerned with improved rail crossings, spring and movable point frogs, and continuous rail crossings. The fourth subsection was devoted to a discussion of Concrete and Embedded Material. Under the head of Locomotives and Rolling Stock one of the most interesting papers dealt with the great increase which has taken place during the past ten years in the size and power of locomotives, an increase amounting on some roads to as much as 45 per cent. The important question of automatic couplers was discussed in papers showing the advantages and disadvantages of such couplers; the improvements effected in their construction, and their use in conjunction with other couplers.

No papers dealt with under this head commanded more absorbing interest than those concerning electric traction, in which its progress on important lines of railways was traced, and the much-discussed questions of the comparative value of continuous, alternating, and polyphase current received lengthy attention.

In Section 3, devoted to the Working of the Railways, the sub-section possessing most interest was that devoted to the Automatic Block System, in which the recent improvements in automatic block signaling were discussed, and it was shown what progress had been made in their introduction. In Section 4, devoted to General Subjects, the questions of slow freight rates, bookkeeping, duration and regulation of work, and provident institutions were the subject of papers and full discussion. In the last section, Light Railways, it was shown what influence the construction of light railways may have had on the traffic of the main lines and working of light railways. The second section under this head was devoted to the consideration of the direct financial co-operation by the State and by localities interested in the development of light railways, and a paper was given outlining the results obtained in Belgium by the institution of a central authority for studying the projects, and supervising the construction and organizing the working of secondary railways constructed with the financial assistance of the State and of the district affected. The third section considered the organization of a cheap service on main railway branch lines which carry little traffic and on light railways. The subject of the last section, Traffic Conveyed by Automobiles, brought the Congress to the consideration of what may safely be termed the very latest development of railway transportation. It dealt with the question of the organization of service of auto-motors on routes where there was not enough traffic for a railway. The development of the separate steam or gasoline-propelled railway car is as important a change, in its more limited sphere, as the electrifying of the main lines of some of the steam railways.

The magnitude of the International Congress may be judged from the fact that the home and foreign delegates together numbered nearly one thousand, and that there was not a single one among these many who was not qualified to rank as an expert in some branch of the complex construction, organization, and management of the world's railroad systems. These delegates come from every corner of the earth; they have built and operated railroads under every possible condition of topography, climate, population, and private and government control. The intercommunication of ideas by papers, addresses, and discussions must result in a general improvement of method, the rejection of old and the incorporation of new and better construction, plant, and operation; results which will be furthered by the personal contact and private exchange of views and experience between individual members.

Vice-President Fairbanks, who in the absence of the President presided at the opening of the Congress, gave a broad touch of human and international interest and meaning to the Congress in some happily-chosen words, when he said that the sessions of the International Railway Congress "bring into closer fellowship distinguished and able representatives of many nations inspired by a wholesome, common impulse. They bring together those who are engaged in promoting the arts of peace and who are desirous of advancing the welfare of mankind. They enlarge the circle of international acquaintance and tend to preserve international amity. They emphasize the fact that our common good is to be promoted by the maintenance of a broad, fraternal, international spirit. While deliberating upon methods to promote the efficiency of the railway, let us hope that you may cultivate a purpose to promote the adjustment, through the arbitrament of reason, so far as may be done consistently with national honor, of those perplexing problems which sometimes arise to menace the world's peace. The nation which seeks an honorable settlement of differences with its neighbors in some other manner than by the sword, is not decadent; it is not wanting in national virility. It is merely manifesting an advanced degree of civilization. It is evidencing the fact that the barbaric strain has run out of its blood. The railroad is one of the most potent agents of modern civilization. With the steamship it has done as much, perhaps more than any other agency to break down the barriers of ignorant prejudice, and unite the world in a common feeling of brotherhood."

AN ELECTRIC PROCESS FOR MANUFACTURING PEAT.

An electric process for the treatment of peat has lately been adopted in England at the Johnson and Phillips works. The peat is transformed into a hard combustible which is well adapted for use under boilers. The operation is said to last about two and a half hours and the material costs less than ordinary coal. The combustible which is thus produced has a high calorific value and gives scarcely any smoke. A plant on a large scale is shortly to be installed in Ireland, and if successful it will be an important move in the direction of utilizing peat as fuel under the best conditions. In the present process the peat as it comes from the bogs is placed in cylinders which revolve at a high speed, and well pressed, while a set of air fans are used to drive off the water which forms about 80 per cent of the total. A set of electrodes is placed in the cylinders and connected with a dynamo. The circuit is completed through the mass of the peat between the electrodes. The resistance which the peat offers to the current causes a considerable heat, and the latter breaks up the peat and pulverizes it, but without causing it to lose any of its properties. In order to increase the conductivity of some kinds of peat, they add certain chemical products. After this process the peat is treated by a set of kneading rollers which give it a plastic consistency so as to enable it to take any desired form. From here it passes to an automatic press which forms it into briquettes. It is then ready for use and is taken to the store-room. It is to be remarked that although the passage of the current through the peat gives rise to a heating effect, the results obtained in this way are quite different from those which another method of heating would produce. By a fire heat the particles of the peat lose their different constituent matters, while the electric heating causes them to disintegrate, thus freeing their cellular material and distributing it throughout the entire mass of the peat. Thus all the particles become adapted for combustion. To obtain a harder material, the disaggregated peat is given a longer treatment with the current. The air is kept out by a tight cover, and the mass is then treated with an adhesive solution so as to unite the particles. The experiments have been made with the above process on a large scale and at a great expense, and it is said to have been greatly improved in the details and can now be applied commercially.

ARTIFICIAL COTTON.

Some recent experiments have been made in Bavaria in regard to preparing artificial cotton from pine wood, and it is said that the new process allows it to be made cheaply enough so that the artificial cotton may compete with the natural product. In the method which has proved the most successful the wood, which has had the bark removed, is cut into thin sticks or fibers one-sixteenth of an inch or less in thickness. These are placed in a large horizontal copper cylinder lined with lead, into which steam is passed. When the separating action of the steam on the wood fiber has been prolonged sufficiently, an acid solution of sodium sulphite is added and the cylinder is heated under a pressure of three atmospheres during thirty-six hours. The wood, which has become completely white, is washed and then passed through a crusher. After washing again, the fibers are further whitened by a chloride of lime treatment. The matter which is thus obtained is dried and constitutes a pure cellulose which is then heated under pressure with a mixture of nitric and hydrochloric acids and chloride of zinc. The pasty mass thus formed is mixed with a little gelatine and castor oil, which give a certain resistance to the fiber. The cellulose is then formed into fine threads by a spinning machine, and these are washed in a carbonate of soda solution and dried. These threads are said to form a very good fabric when woven, and can easily be dyed. Although the experiments have as yet been carried on only in the laboratory, there is no doubt that the process may be applied on a large scale, thus coming into the European market as a competitor for the imported cotton.

SCIENCE NOTES.

A series of discoveries of great value to antiquarians and geographers have been made in the barren desert of the Fayoum by Mr. Seton Karr, the explorer. These investigations show that at some bygone period the old Kurun Lake consisted of a chain of minor oases running in a northwesterly direction from the existing lake and about fifteen miles distant from the actual border line. The explorer brought to light a large number of millstones, plates for grinding meal, and flint implements of the unmistakable Fayoum pattern, strewn over the whole length of the plateau lying parallel to the lake. A number of these trophies, some of which are surmised to belong to the neolithic period, while all afford undoubted evidence of primitive village communities, have been deposited in the Cairo Museum.

The British consul-general at Naples describes in the course of a recent report a new, easy, and commercially profitable system of cultivating truffles that has been discovered by two eminent Italian botanists, Prof. Mattei, who occupies the chair of botany at the Naples University, and Dr. Serra, of Castellammare, who also holds an important position in the botanical world. They have patented a mycelium, and they consider that once the ground has been thoroughly treated therewith, generation will be so spontaneous that further use of what may be called the "protoplasm" becomes unnecessary for a number of years; for the cultivated tuber will propagate itself the same as the wild one has done for unnumbered generations. They further assert that the crop which they propose to sow almost immediately will be ready to be gathered from October onward. Each oak tree is calculated to produce among its roots from 5 to 10 kilogrammes per year, which means that at $2 per kilogramme each tree will produce from $10 to $20 per annum. The chief hope of the botanists referred to, of material profit, however, lies in the *Terfezia leonis*. This species of truffle originates from the roots of *Helianthemum guttatum*, a herbaceous annual which can be sown from year to year where it will best flourish. It is the easiest of all the varieties to grow, and is practically independent of water. In Tripoli the *Terfezia* practically takes the place occupied by the potato in more northern countries. It grows there to the size of an orange, and when taken from the ground is cut up and dried, and carried as food for the caravans which cross the desert. It can be cooked when required, either in water or in camel's milk, and will keep good for an indefinite period.

An important research expedition, which has for its objects the thorough investigation of the hydrography and biology of the central and western sections of the Indian Ocean, which are not explored by the "Challenger" expedition, is to be carried out under private auspices. The British Admiralty survey yacht "Sealark" has been obtained for the purpose. The party will first proceed from Colombo (Ceylon) to the group of coral atolls and submerged banks known as the Chagos Archipelago. This field opens considerable facilities for research, since no clear data regarding this portion of the Indian Ocean has been gathered since 1837. Thence it will go to Mauritius in August, to replenish stores, proceeding subsequently to the surface reef of Cargados and along the Seychelles group and Saya de Mabha bank. This route has been selected for the purpose of conclusively determining the depth of the ocean bed between Mauritius and Seychelles, about which there is at present much diversity of opinion. After leaving the Seychelles the expedition will survey the Agalegas group, finally returning to Colombo. Elaborate soundings and temperature tests are to be carried out, and the determination of the existence of any relatively shallow banks connecting India with the South African continent, or Mauritius with the Seychelles, the mutual relationships of the Chagos atolls, the general ocean changes that have occurred since the last surveys, and the nature of the currents at varying depths. Frequent dredgings will be undertaken for biological purposes, and the examination of the pelagic flora and fauna at various depths from 50 to 500 fathoms, as well as the ocean bed, and all parts of the coral reefs visited. The expedition hopes by this careful survey to obtain some definite information concerning the vertical distribution of animals and plants. The expedition will be absent for several months.

AN ASTRONOMICAL CLOCK WITH AN AUTOMATIC ADJUSTMENT OF TIME AND CHURCH CALENDAR.

BY CHARLES A. BRASSLER.

Be it ever so simple, there is a certain fascination about a clockwork which cannot fail to rivet the attention. That with a spring or a weight and four wheels the period of time between sunrise and sunrise called a day can be divided into eighty-six thousand four hundred exact parts, and this subdivision be repeated indefinitely, is certainly most astonishing and very near akin to a miracle. And yet this is the simplest duty of a clock. Those of us whose qualifications adapt them to extend their observations to the phenomena of nature other than the passage of time, find that certain events occur and constantly recur with marvelous exactness. Mechanical minds are not content with knowing this; they are impelled with a desire to indicate the changes mechanically, and some of the more daring ones reach out to the prediction of the events far into the future centuries.

Having once acquired the knowledge and skill necessary to subdivide one of the smaller periods of time, a day, into its parts, the rest is simply a matter of computation; for, with slight variations which have been discovered, the other events follow successively in regular order and at tolerably regular periods. What mechanism could be conceived, then, which would mark off these occurrences with equal precision to the clockwork, wherein it is possible to cause a wheel to revolve once a minute or once in four years? The phenomena of nature are such daily events as the rising and setting of the sun, of the moon, the ebb and flow of the tides, the longer periods of the seasons, the spring and the neap tides, the church holidays and festivals, the regular yearly revolution of the earth about the sun, the precession of the equinoxes, and with reference to our sphere the movements in their respective orbits of the planets and stars.

Clocks which show all these are called astronomical clocks. Such a clock we are now about to consider, and from the number of these events which it records, and the method by which it does it during a long period of time, correcting automatically the errors which occur in the advancing years, it is entitled to rank among the wonderful productions of the human brain and hand.

Our illustration depicts a highly ornamental clock constructed by Mr. Ernest Weber, a horologist in Georgenthal, Thuringia. By the aid of an armillary sphere, it displays the apparent courses of the stars visible to the unaided eye, combined with some of the phenomena which attend them; it moreover regulates a continual Gregorian time and church calendar (*Computus ecclesiasticus*) as well as a so-called perpetual calendar.

The mechanism is driven by a spring with a winding period of nine days. The escapement, which is plainly visible just above the seconds dial, is a chronometer escapement with a compensated balance vibrating under the influence of a spiral cylinder-shaped spring. Besides this, the case contains a striking work for the hours and an alarm of the same winding period.

With reference to the data in the calendar, be it said that the day of the month changes suddenly every day at midnight, while the name of the month and the week day have an uninterrupted but slow motion. In order not to demand too much power from the main spring at one time, those fixed dates, which remain unaltered through the course of any one year, change successively during the twenty-four hours devoted to December 31 of the closing year, and in such a manner that all the data for the new year are in position and visible at its opening.

To effect these changes more quickly by the aid of the striking work, and at the stroke of twelve midnight, as is the custom with similar clocks, has been avoided here, for the reason, as we shall see later, that it is often desirable to disconnect the sphere movement from the regular clockwork, in order to set it upon some past or future dates; thus all the calendar data, and particularly the festival of Easter, must be capable at the change of the year of moving themselves either forward or backward, which could not be effected if they were attached to the striking mechanism.

AN ASTRONOMICAL CLOCK

that indicates the apparent course of the stars, Gregorian time, and astronomical time, besides including a perpetual calendar.

Though it may be unnecessary, we shall further remark that it is not necessary to change the monthly indicator for months of uneven length, for the clock does this for itself, as well as inserting the intercalary day every fourth year, as also the intercalary day every four hundred years, so that the year 1900 appears as a common year, while 2000 is a leap year, and again 2100, 2200, and 2300 are successively common years. The casing of the clock is a hollow cube of 34 centimeters in height and 27 centimeters in width and depth resting upon four compressed balls for feet. It is provided with a plinth both top and bottom, which is enameled in white and ornamented with gold. Within this compass is contained all the movement of the clock proper, the striking work, the alarm, and the transmission to the globe above. The four sides of the cube are formed of plate glass, behind which the different dials for time, calendar, and holidays are visible. Upon the front, shown in the cut, are seen the following: the date of the current year, stating as to whether it be a common or a leap year, showing February with 28 or 29 days, also the month, the day of the month, the name of the week day, and the day divided into daylight and darkness. Upon the main dial are seen the hours and minutes, divided into the customary twice twelve hours, with the seconds upon a special dial. The several hands upon this dial show the time (mean solar time) for Gotha, the mean time for Europe, as well as that for Greenwich. Moreover, upon two small dials within the ring of the main dial are shown the hours and minutes of the true solar time, as well as the hours, minutes, and seconds of the sidereal or star time, as well for Gotha as for Greenwich, which can be read from the inner ring of the seconds dial.

Upon the side displaying the church calendar appear such data as the ecliptic, the golden number, the Roman indiction, the dominical letters, the epacts, the Luna XIV or date of the spring full moon, as well as the dates of Easter festival and the first Sunday in Advent; besides these, the running time (winding and unwinding work), the alarm dial, and the dial for connecting or disconnecting the striking work. On this side also is found the winding staff. Upon the left side of the casing are shown the days of the week, with the dominical letters and epacts, as well as the dates of the Easter festivals for the future, whereas upon the right side appears the church calendar with the dates of the Ash Wednesdays. Behind the rear face of the cube appear the saints' days and such like as are customarily shown in calendars.

On the platform or upper surface of the cube rests a handsomely decorated foot 24 centimeters high, carrying upon its uppermost end a transparent glass sphere or globe, 17 centimeters in diameter, which turns within meridian and horizon rings of 30 centimeters outside diameter. Upon this glass sphere representing the firmament are visible some of the fixed stars and about it revolve not only the planets, but also the sun and moon in their correct periods. Perched upon the top of all is a small globe representing the earth, and on this is neatly balanced a magnetic needle, which points toward the south instead of the north, its barb having been made the south pole instead of the usual north. This needle is used in adjusting the clock exactly on the meridian of the place wherever it may be situated.

A so-called perpetual calendar is seen on the front of the base of the clock. This is not mechanical, but is manipulated by the hand, and will show instantly a complete year for any date, either in the past or the future.

An idea of the complexity of the work may be gained when we know that it contains more than three hundred wheels and pinions. The height over all is something over three feet, and to keep out the dust and preserve its untarnished appearance, the whole is covered with a glass shade, which for clearness in definition has been left out of the drawing.

Molding the Exterior Concrete Work. The Filling.

Columns Supporting the Interior Structure.

CONCRETE FOUNDATIONS OF THE NEW PASSENGER STATION, WASHINGTON, D. C.

CONCRETE FOUNDATIONS OF THE NEW PASSENGER STATION, WASHINGTON, D. C.

BY DAY ALLEN WILLEY.

The Union passenger station under construction at Washington is notable for the reasor that it is not only one of the most elaborate ever designed, but by reason of the interesting features of construction which it involves. The site chosen for the depot and approaches—at the intersection of Massachusetts and Delaware Avenues—was 22 feet above tidewater, but the main floor of the station is at an elevation of 58 feet, the surface of the basement being 42 feet. To construct the roadbed for the terminal tracks and grade the area surrounding the depot, a large amount of excavation and filling was required, approximating 3,000,000 cubic yards. The contracts for grading the northern approach to the station alone represent 2,600,000 cubic yards of earthwork, in addition to 100,000 yards of masonry; while to bring the site of the station and its surroundings to the required level, no less than 1,000,000 cubic yards of material were needed, the average height of the filling being 20 feet above the ordinary surface. Most of the excavation was performed with steam shovels, each removing 1,000 cubic yards daily.

Detail of Outer Wall Support, Showing Massiveness of Concrete Work.

Because of its architecture and dimensions, the edifice, which is included in the group proposed to be erected to conform to the plan of L'Enfant for improving the city, will be one of the most picturesque and imposing structures of any kind in the United States. Consequently, a brief description may not be out of place in this article. Facing the dome of the Capitol, it will be approached by a grand plaza 1,000 feet in length and 500 feet in width, terraced and ornamented with balustrades and fountains. From the plaza nine thoroughfares will radiate to the east south, west, and northwest. The main building will be 620 feet long and from 65 to 120 feet in height. It is being built of white granite. The three entrance arches will each be 50 feet in height and 30 feet in width, and far exceed in scale their Roman prototypes. These central doorways will lead into a vaulted open-air vestibule, and thence into the main waiting room. At the end pavilions will be located two forty-foot arch carriage entrances, the last one leading to a suite of apartments for the President of the United States and his guests, and the one at the west end will lead to a general carriage porch near the ticket and baggage lobby. The central vestibule and the end pavilions are connected by an open-air portico, and constitute a continuous covered porch along the front of the entire building.

Molds for Interior Columns.

The general waiting room will be 220 feet long by 130 feet wide, and covered by a Roman barrel-vault 90 feet high, that will be decorated with sunken coffers or panels after the manner of the Baths of Diocletian. Natural light will be supplied by a great semicircular window at each end, 75 feet in diameter, and by five semicircular windows 30 feet in diameter, on each side. At the east end of this hall will be grouped the dining room, lunch room, and women's waiting room. At the west end, and on opposite sides of a lobby 50 feet wide, are located the ticket offices and baggage checking room, with the smoking room and package room adjacent. Telephone and telegraph booths will be provided in the general waiting room. The baggage room will be located in the basement, and reached from the west side of the station. To avoid conflict between passengers and baggage on the train platforms, certain platforms will be set aside exclusively for use in handling baggage. The size of the passenger concourse, or lobby, will far exceed anything ever built for a similar purpose. It will be 760 feet long and 130 feet wide, and will be covered by an arched ceiling in a single span, decorated with panels, and part of which will transmit the light.

The building is supported entirely on a base of concrete, and the work of this character is probably the most elaborate which has yet been attempted in America, for no less than 50,000 cubic yards have been required. The columns of the steel framework rest upon columns of concrete, capped with iron, the size varying according to the requirements; while some are only 2½ feet square, others are no less than 6 feet square. The height of the retaining walls and pillars was partly governed by the formation upon which they rest, it being necessary in many instances to make a considerable excavation, in order to obtain a suitable base. To sustain the outside walls, the material was molded into massive piers, both solid and in the form of arches. Some of these masses were no less than 30 feet in length and 20 feet in thickness.

Despite the dimensions of the work and the large amount of material required for the base retaining walls and other supports, a remarkably short time has been required to complete the substructure, and the average number of men that has been employed in handling and mixing the concrete, filling the molds, making and removing the molds, has not been over 150. The material for the station was mixed almost entirely by a gravity process, the idea of Mr. Harlow Lewis, superintendent of construction for the contractors for the foundations and exterior. At a convenient point a trestle was erected, on which the carloads of crushed stone and sand were pushed, being emptied into bins built be-

Panoramic View, Showing Thickness of Concrete Piers for Outer Walls.

CONCRETE FOUNDATIONS OF THE NEW PASSENGER STATION, WASHINGTON, D. C.

neath the trestle. The bins were within reach of a derrick placed on the platform of the mixer. When a batch of concrete was to be made, hand-cars containing buckets were run under the proper bins, and loaded by gravity with the requisite quantity of stone and sand. The buckets were then transferred to the mixing platform by means of the derrick, where the cement was added. The mixer was composed of three hoppers, each having a movable gate or trap in the bottom. In the first or top hopper the sand and stone were combined with the cement, and allowed to fall by gravity into the second hopper, where water was added, then into the third directly beneath it, where the process of composition was completed. From this the material fell into ladles mounted on cars, whence it was hauled by animal power to the vicinity of the mold. Here the loaded ladle was lifted by a derrick, its contents transferred to the mold, then replaced on the car to be again filled at the mixer. The derricks of the ordinary boom type, operated by steam hoisting engines, were set at convenient points on the station site. The tramways used were composed of rails weighing but 15 pounds to a section. Consequently, they could be quickly and easily laid by a half dozen men as fast as needed for moving the material.

At the beginning of the work, iron rods were used in connection with the concrete to give it more strength and tenacity, but wire was finally substituted for reinforcing the material. The sizes set into the material ranged from ¼ to 7/16 of an inch in thickness, depending upon the nature of the work. In setting the wires in the molds, they were placed at an average distance of three inches apart, the outer sections being laid at right angles to each other. As the photographs show, the molds for the walls as well as the interior columns and piers were constructed of wooden framework in the usual manner. Where possible this was built in sections, so that when the concrete had solidified, the false work could be pulled off by means of a derrick, saving the time and expense of knocking it apart. One reason for the rapidity with which the foundations have been built, is the short time required for the concrete to solidify. In the spring and summer months it would set in a maximum period of 36 hours from the time material was poured into the molds in a semi-liquid state. The time in winter is somewhat longer, depending of course upon the temperature.

THE MODERN HIGH-SPEED LOCOMOTIVE.

The great increase that has taken place of late years in the size, weight, and power of fast passenger locomotives, is to be ascribed mainly to two causes. First, the increased weight of the trains, and second, the demand on the behalf of the public for faster trains. Of these two causes, the former has been the most active in influencing the design of the locomotive; for while there has been a decided increase in the speed of express trains, there has been a relatively greater increase in their weight, some of the trains being of a weight which, a few years ago, would have been considered prohibitive.

Contemporaneously with the increase in weight and power of express locomotives, there has taken place a decided change in type. Not many years ago the term "American locomotive," as applied to those that hauled passenger trains, was universally understood to mean an eight-wheel engine with a forward truck, four coupled wheels, and the cylinder driving the leading axle. The call for greater power and a larger boiler then led to the introduction of a third pair of driving wheels, giving us the six-coupled express engine which, for a while, held undisputed possession of the field for heavy fast passenger trains. This, in turn, was succeeded by the celebrated Atlantic type, a ten-wheeled engine with a forward truck, four coupled driving wheels, and a pair of trailing wheels beneath the firebox, the cylinder being connected to the rear driving wheels—a type that is in such wide use to-day that it may be considered the typical American locomotive of the opening years of the twentieth century. It has proved in every respect a most successful type, and some of the heaviest, fastest, and most famous trains in America are hauled exclusively by Atlantic engines. The credit for the introduction of this type belongs largely to the Baldwin Company, and the first engines turned out by them sprang into immediate favor and prominence by the great work they accomplished in hauling the fast summer expresses between Philadelphia and Atlantic City.

The remarkable photograph shown on the front page of this issue represents the most powerful express engine of this type in existence. It was built for the Chicago & Alton Railway, for hauling their fast passenger trains between Chicago and St. Louis during the World's Fair. It is one of several that were ordered, and it formed part of the exhibit of the builders in the Transportation Building at St. Louis. Perhaps the best known of the large Atlantic engines are those which were built by the American Locomotive Company for handling the fast passenger traffic on the New York Central Railroad, and the great power of this Chicago & Alton engine can be understood by comparing its cylinder dimensions with those of the New York Central engine, which are 21½ inches in diameter by 26 inches stroke. The Chicago engine has cylinders of 22 inches diameter and 28 inches stroke, and as the steam pressure, heating surface, and diameter of driving wheel are the same, the engine is, of course, more powerful than the New York Central engines, the tractive force or drawbar pull being 28,798 pounds. The weight on the drivers is 145,000 pounds, the weight of the engine in working order is 221,300 pounds, and the weight of the tender 166,000 pounds. The barrel of the boiler is 70 inches in diameter, and it contains 276 tubes, 2¼ inches in diameter and 20 feet long, whose aggregate heating surface is 3,234 square feet. The firebox contains 202 square feet of heating surface, giving a total heating surface of 3,436 square feet. The driving wheels are 80 inches in diameter.

The engine shown on our front page was engaged in hauling, during last summer, what are known on the Chicago & Alton road as trains No. 2 and No. 11. Train No. 2, running from St. Louis to Chicago, consisted of eight cars which, with baggage and passengers, weighed 475 tons. Five stops were made, the average duration of stops being four minutes, and the average speed of the train was 40 miles an hour including these stops. The weight of train No. 11, running from Chicago to St. Louis, varied from day to day, but frequently no less than fifteen cars were coupled on behind the big engine, in which case the weight of the train, passengers, and baggage exceeded 800 tons. This train was scheduled to make the same speed, and it had to do this in spite of four stops, the average duration of which was 4½ minutes.

When we read of 80-inch driving wheels, 22-inch cylinders, and 70-inch boilers, the average reader receives no adequate impression of the resulting size of the locomotive. In the present case, the photographer selected a point of view that gives one a most impressive sense of the huge bulk and impressive dignity of this splendid engine.

THE GREAT 3,000-MILE YACHT RACE.

The hearts of the deep-sea yachtsmen must have been gladdened on the afternoon of May 16, when they saw that noble fleet of nigh upon a dozen ocean-going yachts sweep over the starting line at the historic Sandy Hook lightship. Of late years, with every recurring international race, we have been accustomed to hear many an expression of regret that the influence of the America Cup contests on yacht design and construction should have resulted in the development of a yacht that was a racing machine pure and simple, costly to build, costly to operate, and practically worthless when the three brief races for the cup had been sailed. There is a large body of yachtsmen, including most of the older men and not a few of the younger and most progressive, that has been endeavoring to control the development of the mere racing machine, and bring back the design and construction of yachts to more reasonable models and more wholesome and less costly materials. There are two effective ways in which this may be accomplished. One is by framing rules of measurement which will give a yacht of wholesome model such a decided advantage in time allowance over yachts of the "freak" type that the motive for building these extreme "measurement cheaters," as they are called, will disappear, and yacht building will be brought back to normal conditions. Another sure way to eliminate the flimsy and freakish yacht is to encourage deep-sea or ocean racing; for it is a fact that the very extremes of form and dimensions which render a yacht fast in the more or less sheltered waters on which the majority of yachting courses are laid, produce a yacht that is entirely unsuited for the severe conditions that may be met on outside courses. Proof of this was shown during the last America cup races, when the "Shamrock" and "Reliance" were afraid to venture outside Sandy Hook one morning in weather that would have delighted the heart of a yachting skipper in the days of the good old ocean schooners "Henrietta," "Fleetwing," and "Dauntless."

The great ocean race which is now under way across the Atlantic will do much to assist in producing racing yachts of a stancher and more seaworthy type, and we may look for a revival of interest in the genuine ocean-going cruiser. This, in its turn, will improve the type of racing yacht that follows the regattas of the summer season; for owners will naturally wish to have a boat that is capable of winning cups, whether the race be over a triangular course of thirty miles off Sandy Hook or a race for the Kaiser's cup for 3,000 miles across the broad Atlantic Ocean.

As to which yacht is likely to win this race, it is altogether idle to speculate. For the past few weeks, and at the present writing, prognostications as to the outcome have been and are very plentiful. The absolute uncertainty as to the winner undoubtedly lends to ocean yacht racing much of the charm that attaches to it. There are so many variable conditions affecting the result. In the first place, there is the wide variety among the yachts themselves; for they range in size from the little 86½-foot schooner "Fleur-de-Lys" up to the great, full-rigged ship "Valhalla," which measures 240 feet on the waterline. They vary in age from Lord Brassey's world-renowned yacht "Sunbeam," now thirty-four years old, to the up-to-date fore-and-aft schooner "Atlantic," built as late as the year 1903. They vary in construction also from the heavy scantling of the "Valhalla," the "Apache," and the "Sunbeam" to the light construction of the out-and-out racing craft, as represented by the German fore-and-aft schooner "Hamburg" and the even more lightly constructed racing yawl "Ailsa." Some of the craft are sailing vessels pure and simple, such as "Fleur-de-Lys," "Thistle," "Ailsa," "Hildegarde," "Endymion," and "Hamburg." Others, such as "Sunbeam," "Valhalla," "Apache," "Utowana," and "Atlantic," are auxiliaries; that is to say, they carry engines and boilers of sufficient power to drive them at a speed of from 8 to 10 knots under steam alone. The auxiliaries, which have unshipped their propellers, are handicapped as compared with the other yachts by the fact that they must carry from 30 to 70 tons of dead weight in the way of engines, boilers, condensers, shafting, etc., which is not as favorably placed for stability as the same amount of weight when carried in the form of lead in the keels of such vessels as "Hamburg" and "Ailsa."

The greatest element of uncertainty is, of course, the weather, and this for the reason that each yacht, or rather each type of yacht, has its own best weather conditions for speed, and a wind that favors one may be disadvantageous for another. It is probable that the yachts will become considerably scattered. Some will take the more northerly and shorter course, disregarding the warnings of the government to the effect that a large amount of ice will be encountered on this course. They will judge that it is better to accept the interruptions, change of course, etc., that will be necessitated in sailing through an ice field, where the ice is closely strewn, and get through the difficult and dangerous belt as quickly as possible; while others again, among whom is Lord Brassey, who will navigate his own ship, will prefer to take a more southerly course, where there will be no fear of being hindered by having to dodge ice floes and bergs. Those who take the northerly course, and have the good luck to avoid collision and escape delay in passing through the ice, will reap a great advantage in being able to sail a course laid on or approximately on a great circle, and, therefore, considerably shorter than a course laid more to the southward. It is this wide scattering of the yachts that brings in one of the greatest elements of uncertainty; for not only will the distance of the course vary, but the weather conditions also may be widely different. Thus a vessel may be so favored with wind and weather to her liking that she may show up at the Lizard ahead of faster competitors, which sailing under their own most favorable conditions could have easily outdistanced her.

Each skipper, of course, is praying that he may have the particular winds and weather that suit his craft. The big "Valhalla" would like nothing better than to have from half to three-quarters of a gale of wind three points aft of the beam for the whole distance; for under these conditions she could reel off 15 knots with ease. The Earl of Crawford informed the writer that on one occasion he sailed the "Valhalla" from Cape St. Vincent to Gibraltar, a distance of 190 knots, at an average speed of 16.8 knots an hour, the maximum possible tide with or against the yacht being 5-10 of a knot an hour. Under such conditions she could drop the fleet easily. But the probability of a continuous wind of, say, 40 to 45 miles an hour for the course is very remote. With head winds she would be easily left by the fore-and-aft-rigged vessels. Lord Brassey informs us that he has logged 300 miles a day in the "Sunbeam." The fore-and-aft schooners like "Thistle," "Hildegarde," "Endymion," "Hamburg," and

THE INTERNATIONAL OCEAN RACE FOR THE KAISER'S CUP.

Yacht.	Rig.	Where built.	Yacht Club.	Length in feet.	Beam in feet.	Draft in feet.	Owner.
Sunbeam.	Auxiliary Schooner.	England.	Royal Yacht Squadron.	154.7	27.6	13.9	Lord Brassey.
Ailsa.	Yawl.	England.	New York Yacht Club.	89.0	25.5	16.6	Henry S. Redmond.
Thistle.	Schooner.	America.	Atlantic Yacht Club.	110.0	27.8	14.0	Robert E. Tod.
Fleur-de-Lys.	Schooner.	America.	New York Yacht Club.	86.5	21.9	13.0	Lewis A. Stimson.
Valhalla.	Auxiliary Ship.	England.	Royal Yacht Squadron.	240.0	37.2	20.0	Earl of Crawford.
Apache.	Auxiliary Bark.	England.	New York Yacht Club.	178.0	28.0	16.6	Edmund Randolph.
Utowana.	Auxiliary Schooner.	America.	New York Yacht Club.	155.0	27.8	14.6	Allison V. Armour.
Atlantic.	Auxiliary Schooner.	America.	New York Yacht Club.	135.0	29.0	16.5	Wilson Marshall.
Hildegarde.	Schooner.	America.	New York Yacht Club.	103.4	26.0	16.9	Edward R. Coleman.
Endymion.	Auxiliary Schooner.	America.	New York Yacht Club.	101.6	24.4	14.0	George Lauder.
Hamburg.	Schooner.	England.	Kaiserlicher Yacht Club.	110.0	23.9	15.0	German Syndicate.

"Atlantic," would like nothing better than to have a whole-sail reaching breeze from start to finish; a breeze with less weight in it than the "Valhalla," "Utowana," "Sunbeam," and "Apache" would call for. Probably under these conditions the race would lie (that is, if the yachts kept the same course) between the German entry "Hamburg" and Wilson Marshall's "Atlantic," with the odds in favor of the "Hamburg," because of her deep lead and greater stability and her ability to carry canvas longer than the auxiliary yacht, although this would be compensated in great measure by the extra sailing length of the big three-masted schooner. Moreover, Capt. Barr, the most successful racing skipper of the day, is familiar with the ocean passage, and the "Atlantic" will be perfectly sailed and handled.

There is one vessel in the race which is notable for the fact that she is the only yacht built as an out-and-out racing craft that is carrying her full racing canvas into the race. We refer to the handsome yawl "Ailsa," built originally as a cutter to defeat that famous yacht of the nineties, "Britannia." "Ailsa's" chance will come if conditions prevail throughout the course similar to those which are ordinarily met with in the regattas of our summer season. If she is favored with light breezes, in which she can use her big spread of canvas to its best advantage, breezes in which the subtle question of ratio of sail area to wetted surface becomes all important, and especially if light head winds should prevail, Grenville Kane and Capt. Miller will be well repaid for the risk they have taken in stepping the big racing mast for this ocean race. Given her weather, "Ailsa" will prove to be a keen competitor for the cup.

The German yacht "Hamburg" is, like the "Ailsa," a strictly racing craft; but her rig has been greatly reduced—a wise precaution, if the winds should be strong and the seas heavy; but likely to spoil her chances if the winds are light.

The big schooner "Atlantic" is generally picked as the winner, and the expectation is based upon her fine performance last season and upon the fact that Capt. Barr, of America Cup fame, is to be her skipper. Given weather in which she can carry her heavy rig, she should win. In heavy weather she will lose to "Hamburg" or to the square-riggers; in light weather and easterly winds, we look for "Ailsa" to prove her most dangerous competitor.

Mont Pelé's New Dome.

BY EDMUND OTIS HOVEY.

The Abbé Yvon climbed two-thirds of the way to the top of the new "dome" of Mont Pelé in the fall of 1904, and the expedition is thus described by him in La Martinique: The party which started for the mountain consisted of himself, the Abbé Altéroche of Morne Vert, M. Roux, gendarme at Le Carbet, and two porters. Leaving Le Carbet by canoe at 5 o'clock in the morning, they arrived at the mouth of the Rivière Blanche at 6:30, and disembarked. The dry bed of the river is now a gorge with walls averaging 15 meters high. Twice they found the gorge blocked by great rocks which formed cliffs 8 to 10 meters high. The first of these was encountered at twenty minutes' walk from the sea, and the second at one hour and a half. Fumaroles were observed at intervals along the river bed from the second kilometer to the foot of the talus of the new cone.

The slope of the material filling the gorge of the Blanche becomes noticeably steeper at an altitude of about 500 meters above the sea. At this point the party stopped, had breakfast, and rested from the fatigues of the rough journey along the new gorge of the Blanche. When the question arose as to the continuance of the ascent, Abbé Altéroche declared himself too weary to go on. In the words of Abbé Yvon:

"M. Roux and Julien, the servant at Morne Vert, consented to follow me, and we directed our steps toward the middle of the base of the talus slope. My project was in general to climb to the level area on top of the 'dome' at the same altitude as the base of the needle which rises on the side toward Morne Lacroix. I was persuaded that the dome ought to be cold and that the fumaroles there, i. e., on the side toward St. Pierre, ought not to have a very high temperature. Furthermore, since the dome fills the crater of 1902 to 100 meters depth, who knows whether or not a new crater, an avenue of communication with the interior of the earth, does not exist in the summit at the place where, as viewed from Morne Vert, there seems to be a level area? Curiosity impelled me to determine the question if possible, and I resolved to climb clear to the top. The volcano was very tranquil and the vapors seemed less abundant than for days before."

After climbing for a few minutes farther, M. Roux decided to go no higher, but he agreed to await the return of Abbé Yvon and Julien; apparently this decision was reached in the breach of the old crater wall and near the base of the new dome. Beyond this point the first fifty meters were rendered difficult to traverse by the loose stones scattered thickly over the slope, which rolled under foot. Then the Abbé reached the white bands which are a prominent feature of the dome as seen from the sea, which he found to be steep slopes* covered with fine white ash. These had been the path of countless dust-flows for two years. Scrambling across the zone of white bands, the two men reached the solid lava of the dome and were able to climb more easily. Noting a large fumarole to the south of their path, they started toward it. This divergence probably saved their lives, since they had scarcely turned aside before an explosion occurred in the upper part of the dome and in a few seconds an avalanche of great rocks traversed the route up which they had been climbing, scattering fragments even to their feet. M. Roux had barely time to take shelter behind a great rock, before the descending stones reached his level. The avalanche lasted about two minutes and impelled M. Roux to start down the mountain at full speed, as soon as it had ceased. The Abbé was determined to go on by a different route, but Julien was thoroughly frightened and would proceed no farther, so that the Abbé was forced to abandon the ascent when about two-thirds of the way up the dome. He was probably at an elevation of about 1,400 meters.

Before beginning the return journey, the large fumarole was visited and was found to be a crevice two or three centimeters wide and 20 to 25 meters long, beside a high, narrow, serrated ridge, resembling the dorsal fin of a fish placed radially with reference to the dome.

Steam was rising vigorously from the fissure to a height of about three meters above the opening. Much sulphur was observed on the farther side of the crack, but the thickness of the deposit was not determined, because it did not seem prudent to cross the fumarole to measure it. On the return journey across the plateau between the Blanche and Sèche rivers and down the gorge of the latter stream, small fumaroles were seen here and there until within half a kilometer of the sea. These were discharging hot air, but no live steam, under some pressure and with considerable noise.

It may be remarked that although the Abbé found the portion of the dome that he ascended essentially cold, he would probably have found a different condition of affairs prevailing on the summit plateau which he was striving to attain, since the December bulletins of the French volcano commission on Martinique report continued explosions from near the top of the mountain and the frequent appearance of incandescent spots near the summit of the dome.

An Inside-Connected Locomotive for Purdue University.

Purdue University is to receive from the New York, New Haven and Hartford Railroad the historic locomotive "Daniel Nason." A few years ago the university interested itself in securing from railways samples of such classes of locomotives as are now being superseded, its purpose being to preserve as museum exhibits types of design which were becoming extinct, and a number of valuable relics are already upon its grounds. From the beginning of this movement an effort has been made to secure a representative of a type which was common throughout New England thirty years ago, namely, an eight-wheeled engine having cylinders inside the frames connecting with the crank axle. This effort has now been crowned with success. The "Daniel Nason" is said to have been built in 1858. It was exhibited in Chicago in 1893 and has since been held as a relic at Roxbury, Mass. The engine weighs about 25 tons, is complete with its tender, and will be shipped to the university at Lafayette, Ind., upon its own wheels.

The university is also to become the custodian, in behalf of the same railway, of a stage-coach passenger car which is said to have been placed in service in 1835. It consists of the body of a stage coach suspended over a simple railway truck by means of thorough braces. It will seat inside and on its top about twenty persons.—American Machinist.

The Current Supplement.

The English correspondent of the Scientific American opens the current Supplement, No. 1533, with an illustrated article on the hydraulic power works on the River Glommen, Norway. Some striking illustrations accompany the text. George W. Dickie's paper on "The Man and the Ship" is concluded. A. Frederick Collins describes the Massie wireless telegraphy system at length. Other articles that deserve to be mentioned are those entitled "Decorative Insulating Beads for Electric Light Wires," "Photographic Chemistry," "The Cement Industry," "A New Form of Friction Clutch," "Salt Furnace for Steel Hardening," "Radium Testing," and the "Present Status of Electric Furnace Working." Karl F. Kellerman discusses copper as an algicide and a disinfectant in water supply.

On the railways of the United Kingdom there is one locomotive and thirty-six vehicles per mile of line. In the United States there is only one per four miles of railway, and thirty-six vehicles per mile.

* These slopes were inclined at an angle of 40 deg., as measured in March, 1903.—E.O.H.

Correspondence.

Why the Stone Ball Moves.

To the Editor of the Scientific American:

The movement of the stone ball may be the result of earth vibration, caused by trains on some railway within a radius of five miles. C. Bartholomew.

East Toronto, May 8, 1905.

Another Solution of the Stone Ball Puzzle.

To the Editor of the Scientific American:

The photograph and article about the stone ball that is slowly moving around interested me very much. I was sure that you would have a good many letters on the subject, but I do not read in any one of them a suggestion that the moving might be due to some metal embedded in the stone, which is being drawn toward the pole as the needle of a compass is naturally drawn. I do not know if the ball is moving in the right direction for this suggestion to be admissible; but might it not be as near the mark as some of the other ones? I hope that some time we may hear the correct solution of the subject. N. L. Ladd.

East Orange, N. J.

That Stone Ball.

To the Editor of the Scientific American:

The spontaneous moving stone ball is a very simple problem, if my theory be right. I am willing to leave the matter to you as to whether it is worth mention or not. It is my opinion, based on the theory that the sphere is unbalanced, not due to imperfection in its shape or symmetry, but to density; in other words, one side is heavier than the other. Then the effect of the expansion and contraction of the base or pedestal upon which the ball rests must be considered. The base has a flat surface directly facing the south, and must of course be affected by the sun's rays, producing the creeping motion of the ball. When the heavy part of the ball has reached the bottom, in my opinion it will cease to move. If it continues to move more than half a revolution, then my theory is wrong. It will take time to settle the matter.

New Paris, Ohio, May 4, 1905. Dr. C. M. Wilcox.

Sentiment Versus Commercialism.

To the Editor of the Scientific American:

Referring to an article entitled "Sentiment Versus Sense" in the Scientific American for May 6, I would like to ask why utilitarian John Pratt does not use the right word? It is not a question of sense, but of dollars and cents. The people who are alive to the beauties of nature, to whom Niagara is not "a great mass of dead matter tumbling in meaningless froth and noise," do not object to a sane withdrawal of water for the production of power.

When, however, the falls are put in danger of ultimate extinction, it will be found that the people of New York State and of the whole country will not be ready to enter upon the "grand and beneficent purpose" of fattening one more corporation. Are the projectors willing to pay for the water? No; if the State offered to sell power for what it is worth, we would not be troubled with these business philanthropists, who would incidentally line their pockets with the millions of dollars which would result from the sale of this power. Nothing that can be put on a good paying basis is safe from the greed of some men. There are other and better standards of value in life than that of money, and we would do well to recognize them.

But whether power is sold or given away, Niagara must not be lost to the millions of people who find delight in it, for the sake of enriching a few capitalists.

H. L. Jackson,

A citizen of New York State.

Boston, Mass, May 7, 1905.

Output of Baltimore Locomotive Works in 1904.

The total output of the Baldwin Locomotive Works for 1904 was 1,453 locomotives, of which 1,352 were steam, 94 electric and 7 compressed air. This is nearly one-third less than the number built in 1903, which was 2,022. The falling off in business, which began in the autumn of 1903, affected the locomotive industry. The works were run at their full capacity until last spring, but from June until the latter part of October very few orders were received. During the year 286 locomotives were exported to the following countries: Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Guatemala, Hawaii, Japan, Korea, Mexico, New Zealand, Peru, Porto Rico and South Africa.—The Railroad Gazette.

A new and ingenious pocket calculator, automatic in its action, has been designed by a German inventor. The device comprises a small case about six inches in length made of steel and aluminium. There is a keyboard of nine figures corresponding to the numerals, and it is additionally provided with a small spring for the supply of the tens and hundreds. There is also a small dial, and by pressing the requisite keys the total amount is recorded upon the dial.

THE MONTGOMERY AEROPLANE.

The first public trial test of the Montgomery aeroplane "Santa Clara," named after the college in which the inventor is professor, took place on Saturday, April 29, in the presence of a large number of invited guests and the representatives of many of the great newspapers of the country. The event was coincident with a regularly observed anniversary of the college, which annually draws together the alumni and many distinguished officials of church and state.

Balloon and Attached Aeroplane Ready to Start.

The Montgomery aeroplane had heretofore made four experimental flights at a little hamlet named St. Leonards, located in the Santa Cruz Mountains to the west, but only in the presence of the inventor, the Rev. R. H. Bell, the aeronaut, and a few farmers. The public was excluded, the private tests being for the benefit of the inventor only, and for an obvious purpose. The same aeroplane was used in each trial, and without modification in construction. Its form and details were unchanged. The experience gained while conducting the early experiments enabled the inventor to determine the best methods of guidance, and to familiarize the aeronaut with the conditions required for successful flight, as well as to inspire him with personal confidence.

The day which was to introduce the new aeroplane to the world officially was in every respect perfect. A light six-knot breeze came out of the north, and the sky was beautifully clear. The sun shone bright. A better day never was known, even in Santa Clara. The necessary aids and appliances were simple and even elementary, and consisted only of a gigantic hot-air balloon, by which the aeroplane was to be elevated. As soon as the great bag began to expand, preparations for the flight were rapidly made. Prof. Montgomery and the intrepid aeronaut, who certainly had most at stake, superintended every detail, intent that no accident should mar the perfect symmetry of the conclusive trial as announced. Minutes progressed, the great balloon was tugging at its full strength, as if anxious to pull itself away from the many hands which detained it. The preparations were at last complete. The aeronaut took his position astride a small carpet-covered saddle, his feet hanging unsupported, his hands clinging to the bracing wires. "All ready!" shouted the professor. "Let go!" was the signal, and at a bound the huge bag quickly sprung a hundred feet in the air, the aeroplane, like a great bird, dangling below. Higher and higher soared the balloon, the gymnast in the saddle having recovered from the momentary thrill of his sudden elevation, and anxious, apparently, to assure the breathless crowd below that his iron nerve had not deserted him and that his composure was undisturbed. To convince, the man clinging to the machine attempted a few acrobatic feats, but they seemed artificial and forced, and subsided at last into a waving of hands. The spectators were cheering vociferously as the balloon ascended rapidly until the form of the aeronaut grew indistinct at the great height.

The ascent continued as long as the hot air could carry the balloon, which was fully 4,000 feet above the ground. The estimate of the operator coincides with this figure. Then the aeroplane was released by cutting the connecting cable, and suddenly dropped, perhaps a hundred feet, when it quickly regained its equilibrium, and floated with the air current. The flight was deliberate, and the descent gradual. A piece of paper dropped from an elevation on a still day might indicate the nature of the flight as it seemed to the spectator.

The operator, in order to demonstrate his supreme control, caused the machine to describe circles, to raise itself, to back and to go forward, and to perform difficult evolutions, which were convincing that the control of the aeroplane in its gradual descent was well within the power of the will of the aeronaut.

The gliding flight of the aeroplane, from the moment of its release from the balloon to the instant of its return to earth again, appeared to the writer like the action of a huge bird on the wing. Persons who have watched the motions of vultures in southern latitudes, know that for long periods these birds will poise high up in the air, and float backward and forward without the flutter of a pinion. To these birds of carrion is given the most graceful and effortless powers of flight, and the aeroplane seemed to imitate the same movements; to follow exactly the deliberation and grace of the vultures in its flight through the air. From the moment the aeroplane left the earth until it landed in a wheat field, three-quarters of a mile away, perhaps twenty minutes elapsed. The ascent started at 11:13 o'clock, and flight concluded at 11:32. The landing was effected with the most perfect ease; the aeroplane emerged from the trial without a scratch. The orders of Prof. Montgomery to the aeronaut were to land at a certain designated spot in a certain field to the southeast of the college grounds. This is exactly what the operator succeeded in doing. In appearance the aeroplane is a light framework of hickory braced in its different sections by light piano wire supporting two wings, 24 feet in length from tip to tip, covered with thin muslin. Together, the wings have a surface of 185 square feet.

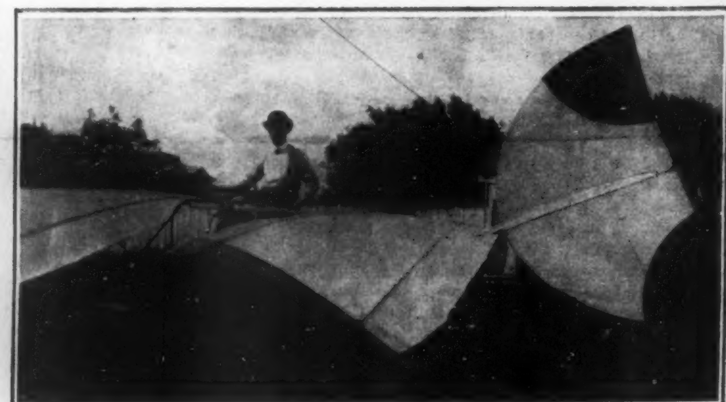
Aeroplane Attached to Balloon.

The wings are fixed on the exterior circumference, but hinged to the light frame on the inner sides. Their shape is parabolic. A rudder, movable, consisting of two half-spherical surfaces, is placed at the rear. Its purpose is to raise or lower the entire machine during its flight. The weight of the flying machine itself is 42 pounds; as the aeronaut weighed 156 pounds, the total weight carried can be readily computed.

The technical description of Prof. Montgomery's aeroplane is as follows:

Prof. Montgomery has, for over twenty years, been a student of atmospheric phenomena, and his researches have led to the discovery of certain laws

The Two Right-Hand Figures are Prof. Montgomery and the Aeronaut.

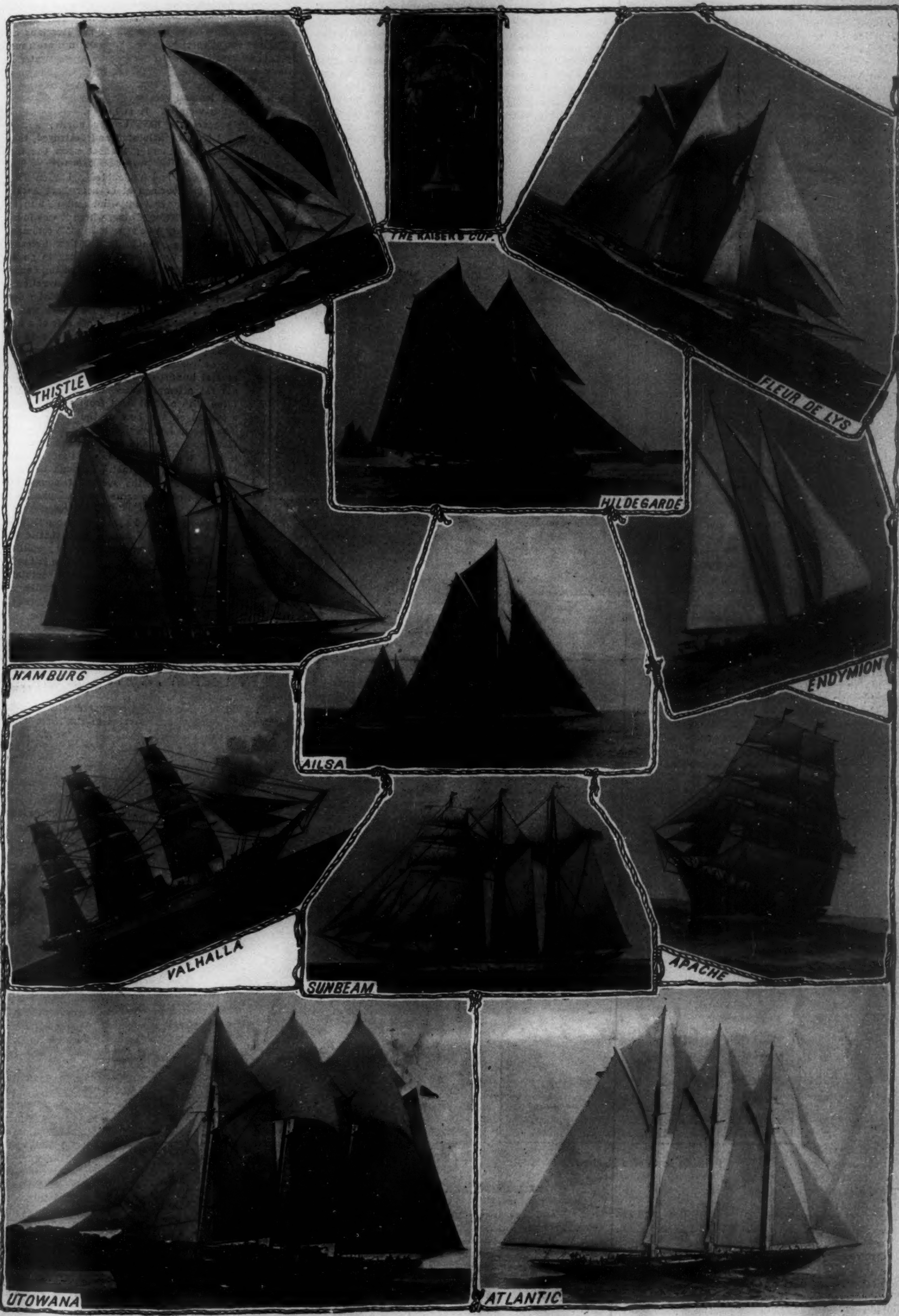


Aeroplane Showing the Tail.

Prof. J. J. Montgomery and His Aeroplane.

General View of the "Santa Clara."

THE MONTGOMERY AEROPLANE.



THE COMPETING YACHTS IN THE KAISER'S OCEAN CUP RACE.—[See page 402.]

governing the motion of air, which are at variance from those generally accepted by scientists. The construction of an airship in accordance with and adapted to these conditions has occupied his attention since 1884. His deductions, after being reduced to a mathematical formula, have resulted in the construction of the aeroplane "Santa Clara." Guided by the practical suggestions given by theories and experiments, the aeroplane used in the present work has been constructed. It consists of two wing surfaces, parabolic from the front to the rear edge, a flat tail, and a vertical keel. The two surfaces are so formed and placed that they lead to a uniform action in the building up of a general rotation, very much as if they were the front and rear portions of a large wing. To this extent they are the elements of a divided wing; yet, inasmuch as they are separate, they have independent modified forms and adjustments, the purpose of this arrangement being to obtain by the use of two points of support, fore-and-aft equilibrium, and yet retain the elements necessary for the production of the complete rotary tendencies in the air. The rear portions of the wing surfaces are hinged at the center, and free to drop from above, but are restrained in their upward movements by wires so adjusted that they may swing like the arms of a balance, yielding automatically to excessive air pressure on one side or to the effort of the aeronaut in contending with unfavorable gusts or directing its course. The relative adjustment of these edges is such that the control of the wings on either side may be similarly changed, or one side move in one direction while the other undergoes an opposite but reciprocal change. The tail or rudder is so placed relative to the rear surface that any change in its position immediately produces a change of pressure along the entire wing, thus meeting the requirements of fore-and-aft equilibrium, these requirements changing with variations of speed as the pressure on the surface moves toward the front edges with increased speed, and *vice versa*. The ventral fin serves partly to preserve the side equilibrium and is so formed and placed as to meet antagonistic requirements of pressure above and beyond the surfaces.

By a change of form and position of the rear surface, the varied pressures necessary to the fore-and-aft equilibrium are developed, and the aeroplane may be caused to dart downward, move horizontally or rise, or to check its position suddenly. With proper manipulation, the machine travels in a wave line through the air, with a gradual descent, turning in circles to the right or left, as the form of the surface on either side is modified.

Owing to generally prevailing ideas on the subject of flight, many exaggerated opinions have been expressed since the first announcement of the experiments with the present aeroplane, which Prof. Montgomery does not sanction, as these may give rise to radical conclusions, and lead to disappointments. It is no doubt true that the experiments were of an extreme nature, for when the aeronaut, at an elevation of several thousand feet, cut loose from the balloon and trusted to the aeroplane, there were only two alternatives before him—a dash to the earth and a crushed and lifeless corpse, or a convincing success of the aeroplane.

In reference to the experiment which the writer witnessed under most satisfactory circumstances, the conclusion is that an advance has been established in the science of navigating the air, though that problem is not yet solved. A great step, in the opinion of the writer, a great leap forward, has been accomplished and maintained. It is but just to Prof. Montgomery and his distinguished coadjutor, the Rev. R. H. Bell, S.J., Professor of Physics in Santa Clara College, that no countenance has been afforded the extravagant declarations relative to the aeroplane which they have jointly conceived. An aeroplane has been constructed that in all circumstances will retain its equilibrium and is subject in its gliding flight to the control and guidance of an operator, but beyond this there remain two other obstacles which are to be overcome before navigating the air is either practically or commercially possible. There remains continuance in flight, as an essential, and lastly, the power of a machine to raise itself from the surface. The first principle has been solved beyond a doubt. The two remaining, perhaps the most difficult of all, await solution.

Driverless Engine.

Germany possesses a miniature but most useful railway, to which no parallel is found in this country. Its peculiarity is that its trains have no drivers. It is used for carrying salt from the salt mines at Stassfurt. The trains consist of thirty trucks, each carrying half a ton of salt. The engines are electric, of twenty-four horse power each. As it aproaches a station, of which there are five along the line, the train automatically rings a bell and the station attendant turns a switch to receive it. He is able to stop it at any moment. To start it again he stands on the locomotive, switches the current and then descends again before the engine has gained speed.—Railroad Men.

In Golden Gate Park, San Francisco, there has been installed a large windmill of the familiar old Dutch type for pumping water. With the wind at ten miles an hour it develops 4.65 horse-power, and at thirty miles an hour the horse-power is 126. Its daily pumping record in June, 1904, ranged from 5,460 gallons to 371,397 gallons against a gage pressure sometimes of 32 pounds and sometimes of 63 pounds.

DESTROYING A RUSSIAN MINE.

The accompanying photographs give a fair idea of the appearance of the mines which the Russians are using to protect their harbors. These mines are usually held several feet below the surface of the water by heavy anchors, but on account of their buoyancy and the action of the tides and storms they frequently break their cables and become a floating menace to all shipping in the vicinity. It is known that scores of these deadly machines have broken adrift; and although several have been located and destroyed, there are many others yet afloat upon the high seas.

The Mine After Being Dragged Ashore.

This one had undoubtedly broken loose from its moorings at or near Port Arthur, and been carried by wind and tide to the harbor of Chefoo, China, where it was found. The discovery was reported to the commanding officer of the U. S. S. "New Orleans," who promptly ordered an officer to go out with a party and destroy the floating danger.

Wishing to investigate the construction of the mine more closely than could be done while it was floating, a long line was attached to it, and from the safe side of a high bank on one of the small islands in the harbor, it was hauled to the beach and up out of the water. The party then went out several hundred yards from shore and after several attempts succeeded in striking the mine with a shell fired from a one-pounder mounted on the bow of the steam launch. The mine, however, could be exploded by electricity only, and although the shell tore a hole through the casing, the guncotton charge remained intact. Through the opening thus made the electrical connections were cut, and the mine rendered practically harmless.

Each of the lead spines on the outside of the mine incloses a thin glass bottle containing acids, and when the spine is bent by collision with a ship or other floating body, the bottle is broken and the acids emptied into a receptacle containing zinc-carbon elements. The combination instantly produces an electrical current and the spark ignites a fulminate detonator, which in turn explodes the main charge of about 250 pounds of wet guncotton.

After the mechanism had been carefully examined electrical connections were laid from the mine to the lee side of the bluffs which are seen in the accompanying photographs and the charge exploded from a safe distance.

This Russian mine may be compared with the Japanese mine which was illustrated in the issue of the Scientific American of March 11 of this year. In the Japanese mine, the firing arrangement consisted of a ball carried on a flexible vertical rod, provided with a contact disk which, when the mine was struck, came in contact with a ring of metal and closed the electrical circuit, thereby detonating the mine. The chief interest in this Russian mine lies in the contact mechanism, which would not appear to have been very effective, at least in this particular mine, inasmuch as when the mine was dragged ashore, the lead spines must have been bent and the glass bottles broken without causing the firing mechanism to operate. During the Spanish war, immunity from disaster from submarine mines, in the case of at least two of our warships, was due to the fact that the contact fingers or triggers, which should have detonated the mines, were so incrusted with marine growth and otherwise out of order, that although the mines were struck and roughly handled, one of them being torn adrift by the propellers of the "Texas," no damage was done.

Drifting in Chefoo Harbor.

American Officers Examining Shothole in the Mine.

DESTROYING A RUSSIAN MINE.

Incandescent gases under slight pressure give light composed of lines, but under pressure a continuous spectrum.

COMPARATIVE TESTS OF STEAM AND ELECTRIC LOCOMOTIVES.

In our issue of February 18 of this year will be found an illustrated article describing the six-mile stretch of experimental track upon which the New York Central Railroad Company is carrying on very exhaustive tests of its new electric equipment. This locomotive is the first of a large order, and it is the type to which will be intrusted the important work of handling the express-train service running into and out of New York city. The tests were carried on day by day, throughout the whole of the winter and spring under every condition of weather. On April 29 last, it was decided to carry through a series of comparative tests between the new electric locomotive and the newest and most powerful express locomotive that is now handling the New York Central trains. There were two sets of tests, one with an eight-car and one with a six-car train. The steam locomotive, which is a truly enormous engine, has 22 x 26-inch cylinders, 3,757 square feet of heating surface, and weighs with its tender, 342,000 pounds. In the first test it was placed on the express tracks, opposite the point at which the electrically-equipped local stretch of track begins, with eight or six passenger cars behind it. The electric locomotive, which weighs 200,500 pounds, was placed on the electric tracks with the same number of cars behind it, and these cars were loaded so as to bring up the total weight of engine and train to that of the steam train with its engine. Consequently, the electric locomotive was hauling, in the case of the eight-car train, a load greater than that hauled by the steam locomotive by 70.75 tons. This fact should be borne carefully in mind if we would appreciate the great superiority shown by the electric locomotive. In every test the two trains started from rest, and careful records were made of the speed, distance, time, and power consumption. The trials were witnessed by Mr. W. J. Wilgus, vice-president, and Mr. E. B. Kettee, electrical engineer of the New York Central Railroad Company, and by Mr. E. W. Rice and other officers of the General Electric Company, the builders of the engine.

Time of Test and Weather Conditions.—The test started about 8 A. M. and continued until about 1 P. M. of April 29, 1905; temperature averaging about 50 deg. Fahr., cloudy. During the time of the test no rain fell, so that the rails were perfectly dry.

Description of Experimental Track.—The experimental track, six miles in length, is the portion of old track No. 4 formerly used for east-bound freight movements between mile-posts 162 and 168 west of Schenectady. The working conductor consists of top-contact 70-pound steel rail reinforced with copper, and covered in part with a board protection. The alignment and grades on the six-mile stretch of track ("race track" for the time being) are easy. From the easterly end of the track at mile-post 162, going westerly, the rising gradients vary from 5 feet to 17 feet per mile to a summit between mile-posts 166 and 167, and thence the track descends on gradients varying from 6 to 19 feet per mile to the end of the track at mile-post 168. In the six miles there are seven curves varying from 0 deg. 48 min. to 20 deg. 17 min., the maximum length of tangent being 7,565 feet.

Source of Power, Transmission Line and Sub-Station.—The power for testing purposes is furnished by the General Electric Company, and for this purpose there has been installed at their Schenectady plant a 2,000-kilowatt three-phase 25-cycle Curtis turbo-generator, delivering 11,000 volts to the line. A special high-tension transmission line has been constructed for the intervening distance of about five miles to a sub-station that has been erected by the railroad company near mile-post 165. This sub-station contains a 1,500 kilowatt, 650-volt rotary converter, with static transformers for reducing the potential from 11,000 volts to 475 volts.

Dimensions and Weights of the Test Trains.—The weights of the cars and locomotives were as follows:

EIGHT-CAR TRAIN.

Electric Train.			Steam Train.		
No.	Car No.	Weight Loaded.	No.	Car No.	Weight No Load.
1	1060	101,900	1	2527	79,900
2	1070	100,400	2	1547	86,100
3	1069	106,200	3	1534	87,800
4	1062	100,100	4	1521	84,500
5	1067	104,650	5	1069	86,300
6	1550	102,800	6	1099	87,400
7	1552	106,000	7	1543	88,400
8	1558	104,750	8	1519	86,700
	Locomo.	200,500		Locomo.	342,000
	Total,	513.6 tons		Total,	513 tons

It will be noted that, due to the restricted cross-section of conductors, the voltage dropped during acceleration considerably lower than will obtain in actual practice within the electric zone in the neighborhood of New York. Therefore the results obtained in this comparative test are much less favorable for the electric locomotive than will be secured in actual practice.

Run "A".—The "Pacific" type steam locomotive had an eight-car train, with a total weight, including the locomotive, of 513 tons, as compared with the eight-car train behind the electric locomotive weighing 513.6 tons. Both trains started together, with the steam locomotive accelerating faster than the electric locomotive, due to the abnormal drop in voltage from the pressure at the station of 700 volts to a track voltage as low as 325 volts. At 3,000 feet from the starting point the electric locomotive gained the same speed as the steam locomotive, and from that point accelerated more rapidly, so that at a distance of two miles from the starting point the electric locomotive passed the steam locomotive, and at the shutting-off point was two train lengths ahead. The maximum speed of the steam locomotive was 50 miles per hour. The maximum speed of the electric locomotive was 57 miles per hour.

Run "B".—This run was made under the same conditions as run "A," with results practically the same, except that the speeds were higher, as follows: Maximum speed of steam locomotive, 53.6 miles per hour; maximum speed of electric locomotive, 60 miles per hour.

Run "C".—This run was made with six-car train for both locomotives, with total train weights as follows: Electric locomotive, 407.5 tons; steam locomotive, 427 tons. Owing to extreme low voltage under the conditions above stated, which during acceleration fell as low as 330 volts, at first the steam locomotive accelerated more rapidly, but at the end of about a mile the electric locomotive overtook the steam train, and continued to forge ahead until the power was shut off. Maximum speed of electric locomotive, 61.6 miles per hour; maximum speed of steam locomotive, 56 miles per hour.

Run "D".—In order to secure as nearly as possible results comparable with the conditions of voltage that will obtain in the actual operating zone, this run with six-car trains, similar to those used in run "C," was started at a point nearer the sub-station, near mile-post 164. For this run the electric locomotive from the first turn of the wheels accelerated faster than the steam locomotive, as plainly illustrated in the attached photograph, where at a distance of 1,500 feet from the starting point the electric locomotive led by a train length.

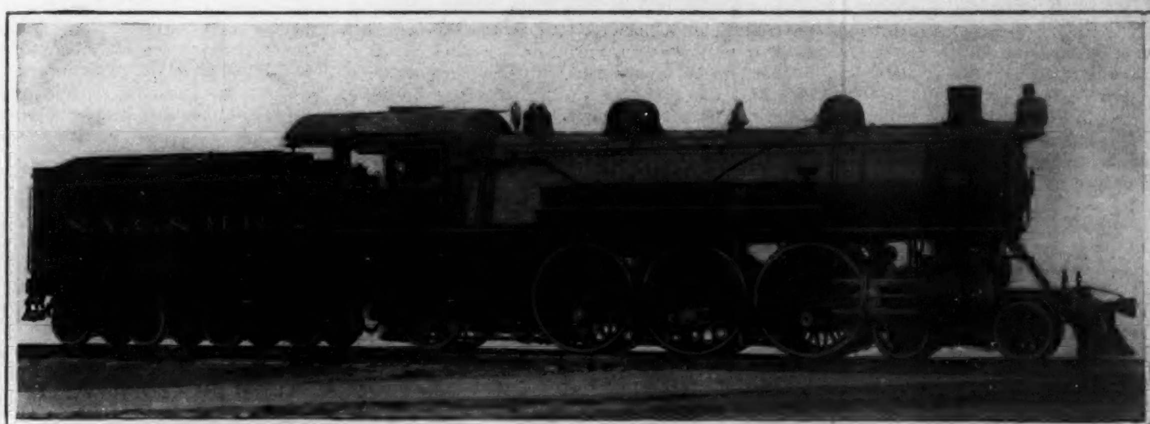
Run "E".—This run was made with the electric locomotive and one coach, a maximum speed of 79 miles per hour having been attained.

Run "F".—This run was made with the electric locomotive running light and with the power shut off on curves, a maximum speed having been attained of 80.2 miles per hour.

Had it not been necessary to shut off the current on curves, it is believed that the locomotive would have attained a speed of over 90 miles per hour in this comparatively short run.*

Electric Train Pulling Clear of Steam Train at 1500 Feet from the Start.

STEAM VERSUS ELECTRICITY.



Cylinders, 22 x 26 Inches. Heating Surface, 3757 Square Feet. Drawbar Pull, 28,500 Pounds.

THE POWERFUL 170-TON STEAM LOCOMOTIVE USED IN THE NEW YORK CENTRAL SPEED TESTS.

SIX-CAR TRAIN.

Electric Train.			Steam Train.		
No.	Car No.	Weight Loaded.	No.	Car No.	Weight No Load.
1	1060	101,900	1	2527	79,900
2	1070	100,400	2	1547	86,100
3	1062	100,100	3	1534	87,800
4	1067	104,650	4	1521	84,500
5	1550	102,800	5	1069	86,300
6	1558	104,750	6	1099	87,400
	Locomo.	200,500		Locomo.	342,000
	Total,	407.5 tons		Total,	427 tons

AVERAGE VOLTAGE DURING ACCELERATION.

Runs.	Series.	Series-Multiple.	Multiple.
A	520	540	325
B	620	580	275
C	600	640	290
D	680	680	515
E	650	600	420
F	600	620	455

Summary of Results.—The most important test is run "D," as the voltage during that test more nearly approached the conditions that will be obtained in the electric zone. Therefore, the following comparison of the steam and electric locomotives based upon the results of run "D" are very interesting as illustrating the marked superiority in acceleration of the electric locomotive over the steam locomotive, considering the fact that the "Pacific" type of steam locomotive has practically the same weight upon the drivers.

CONDITION IN RUN "D."

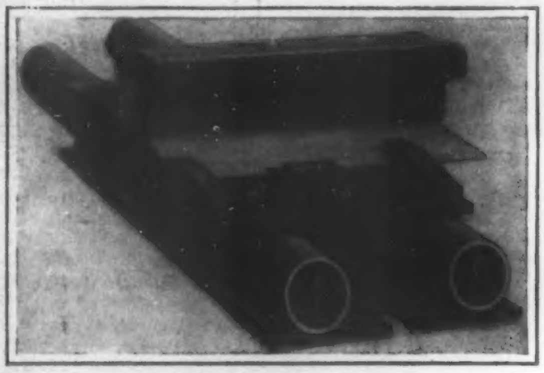
	Steam.	Electric.	Difference in favor of Electric.
Length over all............	67 ft. 7¾ in.	36 ft. 11¼ in.	30 ft. 8½ in.
Total weight (inc. tender for steam locomotive)....	342,000 lb.	200,500 lb.	141,500 lb.
Concentrated weight on each driving axle.........	47,000 lb.	35,500 lb.	11,500 lb.
Revenue-bearing load back of locomotive............	256 tons.	307.25 tons.	51.25 tons.
Acceleration miles per hour per second average up to 50 M. P. H...........	0.246	0.394	0.148
Time required to reach speed of 50 M. P. H.......	203 sec.	127 sec.	76 sec.

* A speed test on May 1 reached 85 miles per hour with a limitation on the 2 deg. 17 min. curve of 75 miles per hour.

Patent Department

RAILROAD TIE AND CLAMP.

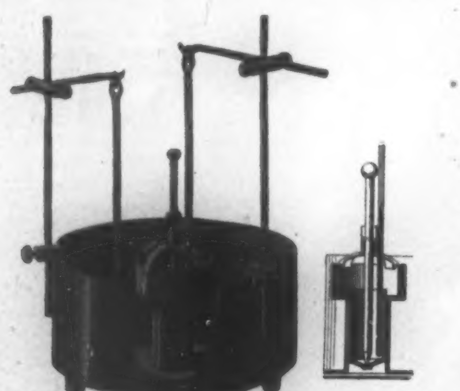
Pictured in the accompanying engraving is an improved railway tie and clamp recently patented by Mr. Henry S. Kilbourne, of Hayden Building, Nashville, Tenn. The construction is quite simple and inexpensive, and yet it possesses great strength and durability. The tie is composed of two steel tubes united near their extremities by steel plates, *A* and *B*. The latter are formed with saddles which fit the tubes, *C*, and are welded thereto. This arrangement is preferably used in light road construction. Where it seems advisable to give the tubes additional strength, the plates are formed with sleeves which are shrunk on to the tubes. The clamp consists of bars, *D*, which are bent at the ends to hook under the edges of plate, *B*, on which the bars rest. These bars are formed with jaws to receive the base flanges of the rails. Each bar, *D*, is provided with a tongue, *E*, bent downward at the rear, forming an ear which projects below the plate, *B*. The clamping plates on opposite sides of the rail are joined by a bolt, which passes under the plate, *B*, between the tubes, *C*, and through ears, *E*, against which the nuts on the bolt are tightened. The bolt is threaded at each end, but the main body is of square cross section, so that it will fit snugly against the under face of the plate, *B*, which is provided with a recess in each end to receive lugs formed on the bolt. In practice it would probably be found advisable to fill the tubes, *C*, with broken stone or ballast. The tubes may be plugged up to prevent entrance of water. On curves, where there is a tendency for the track to shift laterally, the plates, *A*, may be formed with flanges, which would press down into the roadbed and hold the track secure.



RAILROAD TIE AND CLAMP.

AN IMPROVED VISCOSIMETER.

In the accompanying engraving we illustrate an improved apparatus adapted for determining the viscosity of oils. The principle on which the apparatus operates is very simple. The oil is heated to a predetermined temperature, and then permitted to flow through an orifice of given dimensions, when its viscosity will be ascertained by the length of time required for the oil to pass through the orifice. The viscosimeter consists of a container or bath for oil, supported on a standard. The legs of the standard terminate in blocks, through which leveling screws are threaded. Attached to one of the legs is a Bunsen burner, which may be clamped at any desired position below the oil retainer. The retainer is formed with a central sleeve, into which is fitted a testing cup. A trough surrounds the upper end of the cup, to receive any oil that may overflow, due to expansion when it is heated to the required temperature. In the bottom of the cup is the orifice through which the heated oil must flow. Normally, however, the orifice is closed by a needle valve, the stem of which is guided in a sleeve carried by a spider resting on the rim of the trough. The sleeve is slotted to receive a pin on the stem of the valve. When it is desired to hold the valve open, the stem is raised and turned, so that the pin will rest on the upper edge of the sleeve. Two thermometers are used, one for the bath, and the other for the test cup. They are suspended from adjustable supports, clamped to the retainer. In operation, oil is placed in the bath and also in the testing cup, the latter being filled nearly to the top. Then, after leveling the apparatus and placing the thermometer in position, the gas is lighted, and when the same degree of temperature is indicated in the two thermometers, this degree being, of course, predetermined and depending on the character of the oil, the needle valve is raised, permitting the oil to pass in drops from the cup into a suitable receptacle. By means of a stop watch or the like, the time elapsed in the passing of the oil through the orifice, into this receiver, will give the viscosity of the oil. A patent on this viscosimeter is owned by the Fiske Brothers Refining Company, of 59 Water Street, New York city.



AN IMPROVED VISCOSIMETER.

Brief Notes Concerning Patents.

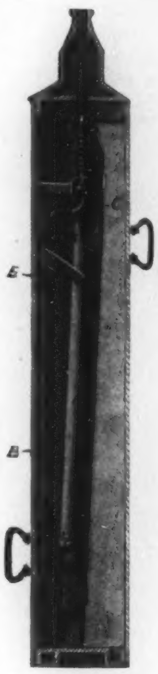
During the latter part of December last, the death took place of Henry Hohorst, a resident of Brooklyn, who for forty years had been a very prominent person in shipping circles. He was the inventor of several pieces of machinery for the loading and unloading of vessels. He was born in Bremen, Germany, eighty-three years ago.

An addition to pleasure cars of that kind established mainly at fairs and seaside amusement resorts, has been furnished by the recent invention made by Mr. J. D. Walsh, of St. Louis. This inventor provides a car whose axles are secured eccentrically to the running wheels, so that as the latter roll along either on an inclined or a horizontal track, the car body will oscillate up and down, producing a rocking sensation intended to be highly exhilarating and enjoyable to occupants who find pleasure in this sort of diversion. From the arrangement described above, the inventor claims that the character of oscillations imparted to the car may be almost unlimited, and need to be neither regular nor happen at the same time. This may be readily done by using on the forward trucks wheels of different diameter from those of the rear trucks.

A life-saving belt which has a number of features which are unique, if nothing else, was recently given a trial at Los Angeles, Cal., which is the home of the inventor, Z. C. Angevine. The device is of the nature of a canvas jacket, which is tied around the chest by means of stout cords. The interior is rubber-lined and divided into a number of compartments, so that in case one or more should become damaged from any reason whatever, the buoyancy of the remainder would be sufficient to keep the jacket and its wearer afloat. Besides this water-tight bulkhead construction, the coat is supplied with a number of pockets which the inventor has filled with articles that he divines would be of use to a person adrift on the high seas. The provisions consist of concentrated foods, a quart of stimulants which might be consumed by the aid of a rubber hose conveniently located, a gallon of water for drinking purposes, an aluminium pouch for the reception of valuables, a gun and set of signal cartridges, a collapsible pole eight feet long with an inverted American flag on it as a means to attract assistance, a knife and some other things of minor importance, which might assist in making the wearer of the belt quite comfortable. The inventor says that a person wearing one of these belts is provisioned for five days. At the test referred to, it was shown that besides carrying the load of supplies tucked about in the various compartments of the coat, the garment had a capacity of supporting three persons in the water without any effort on their part. The inventor expects to realize quite handsomely by selling and renting the life-saving coats to persons compelled to go to sea.

AN IMPROVED FIRE EXTINGUISHER.

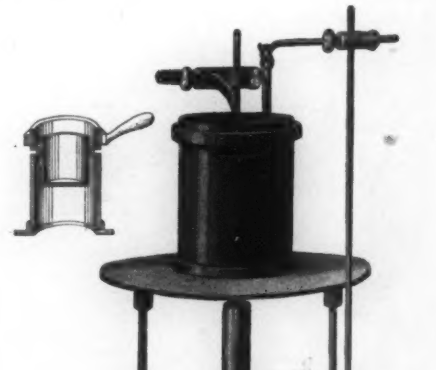
A patent has recently been procured by Mr. Charles W. Aton, of Clairton, Pa., on an improved fire extinguisher, which we illustrate herewith. The construction is such that upon inverting the extinguisher, chemicals for exerting pressure will be set free, and thereupon the fluid will be forced out of the nozzle in any direction desired. The device can be charged with a higher pressure than most fire extinguishers, and is, therefore, particularly adapted for use in shops and warehouses with high ceilings, and also for passenger coaches and stations. The handles are insulated so that the fluid can be directed upon highly-charged electrical wires without danger. The device consists of a tubular casing closed at one end by a plug threaded therein, and at the other by a cap in which the nozzle is formed. Within the casing is a large tube, *A*, and a smaller one, *B*. The latter is coupled at its upper end to a small duct, which enters a sleeve projecting inward from the nozzle. A spring-pressed coupling on this sleeve makes a tight joint between the sleeve and the duct. In the upper end of the tube, *A*, is the acid bottle, *C*. The clip which holds the tube, *A*, in place projects through openings in the latter, and holds the bottle, *C*, also. A plug is similarly held at the lower end of the tube, and on this plug a ball, *D*, rests. When the extinguisher is inverted, the ball rolls down and breaks the frangible bottom of the bottle, *C*, and the gases immediately generated rise and collect in the bottom of the inverted receptacle. Thence they pass into the tube, *B*, forcing the fluid in the latter out through the nozzle. The fluid enters the tube, *B*, through the valve, *E*. The latter, however, is so arranged that it will close when the device is turned nozzle upward, and then the fluid enters through the perforations at lower end of the tube under pressure of the gas, which will then have risen to the top of the receptacle.



AN IMPROVED FIRE EXTINGUISHER.

APPARATUS FOR TESTING FLASHING POINTS OF OILS.

A patent has recently been secured by the Fiske Brothers Refining Company, of 59 Water Street, New York city, on an improved device for determining the flashing points of inflammable liquids, such as oils. The device is of simple construction, easily kept clean, and so arranged that the igniting flame will pass over the surface of the oil in a uniform and practically horizontal direction. The apparatus comprises a ring-like support, mounted on legs provided with leveling screws at their lower ends. Resting on the ring is a flue, which receives the flame from a Bunsen burner clamped to one of the legs. A test cup fits into the upper end of the flue, resting on lugs formed on the rim of the flue. This test cup is provided with a trough surrounding its upper end, which is designed to receive any overflow of oil due to its expansion when heated. A gas-burner tip is adjustably supported over the cup, and the thermometer is hung from an adjustable arm clamped to one of the legs of the standard. In operation the apparatus is first leveled, and then the cup is filled nearly to the brim with oil. The Bunsen burner is adjusted to regulate the thermometer, which is suspended with its bulb immersed in the oil. The burner tip is now adjusted to extend slightly over the edge of the test cup. The flame from the tip will then pass in a substantially horizontal plane over the surface of the oil, and when the oil flashes, its flash point will be indicated by the mercury in the thermometer.



APPARATUS FOR TESTING FLASHING POINTS OF OILS.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

DYNAMO OR MOTOR.—J. A. TITZEL, SR., Washington, Pa. In this machine there is a revoluble armature and a fragmentary field, the latter consisting of separate groups of magnets mounted upon sector-like blocks which are detachably secured to a circular frame. The field magnets are arranged to act successively upon separate magnets of the armature, and the blocks carrying field magnets are adjustable relatively to the frame. All magnets, both in field and armature are provided with poles disposed tangentally so as to improve the magnetic field. The machine may be made comparatively light in proportion to power of current.

Of Interest to Farmers.

BINDER ATTACHMENT.—A. WILLIAMS, Joliet, Mont. In this patent the invention is an improvement in self-binding harvesters, being in the nature of a seed-saving attachment by which to collect grain and grass-seed which are ordinarily wasted off the deck of a binder. A box is so arranged as to receive the seeds as they discharge from the table, and the binder-table being inclined downward toward the box to discharge the seeds thereto.

TRACTION-ENGINE.—B. B. STAUFFER, Kansas City, Mo. The invention relates to traction-engines or portable engines, and its object is to provide an improved steering mechanism by means of which the power of the engine may be utilized, if desired, for steering purposes. The improvement can be attached to traction-engines of ordinary construction without necessitating the removal of different parts.

CANE-HARVESTER.—G. D. LUCE, New Orleans, La. The particular object of this invention resides in a novel form of feeding and carrying mechanism. As the machine moves forward the cane will pass between divergent portions of the chain and be carried to the cutters, and then the cut cane will be moved rearward while in upright position and discharged in windrows, and the cane will be carried over the rear end of the frame or lifted above the same as the carrier-chains are inclined upward toward the rear. Improvements are substantially of the character of harvesters shown in former patents granted to Mr. Luce.

HAY-SWEEP ATTACHMENT.—J. R. JUDGE, Anselmo, Neb. The object of this inventor is to provide a novel attachment for a hay-gathering sweep which will effect a proper deposit of a load of hay from the sweep onto the stacker and prevent the dislodgment of any portion of the load upon withdrawing the sweep from the stacker, which will expedite the work and lessen the labor entailed in operating a stacker and sweep.

CULTIVATOR.—S. H. COLEMAN, Villisca, Iowa. The cultivator is especially adapted for working corn and garden-truck; and the inventor's purpose is to provide a light, durable, and economic apparatus of such arrangement that the blades or shares may be made to enter more or less deeply into the ground and will cut at each passage all weeds between the rows, pulverizing the ground and hilling up the plants in many respects better than shovel-cultivators. The blades enter the ground readily and work equally as well on rough soddy ground as on soft and will also efficiently work on a hillside. It will not choke or become clogged when cornstalks, trash or clods are in the way.

COTTON-PICKER.—S. L. BOND, Charleston, S. C. In this case the invention pertains to cotton-pickers; and its object is to produce a simple device of its class which is provided with improved means for picking the cotton and delivering it into a receptacle. The device is expected to be pushed along by a plantation hand and can be completely controlled by one person.

Of General Interest.

PLATING APPARATUS.—L. SCHULTE, New York, N. Y. This invention relates to electro-chemistry; and its object is to provide an apparatus for plating all kinds of articles, especially, however, sheet metal, band-iron, wire, and the like, arranged to allow the use of a high current to plate the article in a comparatively short time, to insure uniform plating of the entire surface of the article, and to give a bright appearance to the deposit.

SOAP-DISPENSING APPARATUS.—W. R. SALTZGABER and C. J. CARMICHAEL, Knoxville, Tenn. This improved apparatus is particularly adapted for all public places where the toilet articles are promiscuously used, since it not only effects economy, but will absolutely obviate the danger of infection from the use of soap which has been contaminated by persons previously handling it. In this connection it should be noted that not only can the soap be supplied to the receptacle in an unevaporable and sterile condition and so maintained, but that it is unnecessary for the user to handle any portion of the apparatus at any time.

ANTISEPTIC BOTTLE.—F. SONNENFELD and J. GLASS, New York, N. Y. It is the principal object of the inventors to provide a bottle or receptacle which may be refilled and used an indefinite number of times without the possibility of carrying disease-germs or poisonous chemical compounds when it is submitted to an ordinary washing process, and which, being transparent, will indicate to the public the fact of containing foreign substances, so as to necessitate thorough cleaning before refilling.

FISH-HOOK.—W. E. KOCH, Whitehall, N. Y. This invention refers particularly to improvements in hooks of the gang type used for trolling, an object being to provide in connection with a main hook a simple means for attaching an auxiliary or gang of hooks thereto, the connection between the parts being such as to cause the bait-minnow, either alive or dead, to float in an upright and natural position.

MINER'S LAMP.—F. KOCH, West Hazleton, Pa. The object of the inventor is to provide in connection with a lamp-spout a wick-raiser arranged to prevent leakage. To project a wick the wick-raiser is moved downward, and then upon an upward movement the inwardly-turned portion of a plate will engage in the wick and cause its upward movement with the plate. During downward movement of the plate the teeth in the upper end of the tube will prevent a downward movement of the wick.

MOLD FOR FORMING CEMENT BUILDING-BLOCKS.—B. ELY and J. I. TAYLOR, Rock Rapids, Iowa. In this case the invention is an improvement in knock-down or separable molds adapted for forming clay or cement building-blocks having cavities or passages, permitting circulation of air. The invention relates particularly to the means for forming longitudinal and transverse air-passages in the molded block and also to the means for forming a thin block adapted for use as a facing or veneering for walls of buildings.

METHOD OF WELDING.—O. EIGEN, 12 Brauerstrasse, Duisburg, Germany. The two extremities of a chain-link, of two bars, rails, or the like to be welded together and which have been heated to welding heat are submitted to the action of two pressure-rolls rotating in same direction in such manner that the extremities to be united are pressed one against the other both in longitudinal direction of bar and also transversely of same. These rolls may act upon the joint either with equal or unequal circumferential velocities. If velocities of rolls are different, parts to be welded together will not only be pressed together, but the work will at same time be advanced between the rolls. Displacement of work may be effected mechanically by any other means.

MAIL-BOX.—J. H. DICKSON, Polk, Pa. The purpose of the invention is to provide a mail-box which will require the use of but one hand to place letters within and to so construct the box that it will be strong, compact and simple and able to stand any reasonable test and wherein also the box will be waterproof and practically burglar-proof.

BUTTON ATTACHMENT FOR GARMENTS.—J. D. BURNS, Washington, D. C. That class of buttons which are provided with means for attaching them to a garment are improved by this invention. Mr. Burns employs for this purpose a wire which is permanently attached to a button and formed with a spiral coil adjacent to the latter, the wire being extended laterally from the coil so to form a piercing-point and lever, which is utilized in applying the button to a garment.

ICE-CREEPER.—E. C. BARTLEY, Mifflintown, Pa. This device is designed to be secured to the heel of an ordinary boot or shoe, or to be worn with rubbers or overshoes. For the purpose intended it is a simple, cheap, and efficient article which can when not in use be folded into a small compass to enable it to be readily carried in the pocket, etc.

SPLASH-GUARD FOR BATHING APPARATUS.—E. J. BISSELL, Bartold, Mo. The purpose of this inventor is to provide a convenient and economical guard which may be conveniently attached to an ordinary washtub or to one or two pails. Broadly stated, his invention comprises a guard arranged to be placed on top of one or two vessels, with an opening provided in the bottom of the basin opposite either one or both of the vessels.

SAFETY-RAZOR.—B. KIAM, New Orleans, La. In operation the guard-plate and blade may be readily removed and replaced at will, thus facilitating the thorough cleansing of the razor, and Mr. Kiam is able to secure the blade in place without perforating the said blade and also without perforating the guard-plate which presses against the blade and bends the same to any desired curve in the use of the invention.

DISINFECTING DEVICE.—G. KRUEGER, Johnstown, Pa. The invention refers to devices for the burning of disinfectants, it being particularly useful in connection with the combustion of sulfur to produce sulfurous-acid vapor. Its principal objects are to provide a convenient and effective device for the purpose. The vessel for the combustible is supported with a body of water, thus obviating any danger of fire or damage to surrounding objects.

HAIR-TONIC.—E. MAROSI, New York, N. Y. The compound consists of the following ingredients combined in the proportions stated—viz., infusion of one-half pound of mustard seed, one-quarter pound of white rosin, and one pint of turpentine. The liquid compound is repeatedly rubbed on the bald head of the human body to insure the formation of a new growth of hair.

ABDOMINAL CORSET.—C. MUNTER, New York, N. Y. One purpose of this invention is to provide an article of apparel which serves as a conformer for the body and which may be readily applied and operated to properly shape the figure at the waist, stomach, and hips and which can be comfortably worn with beneficial effect. It provides for an equal distribution of flesh over parts not naturally fleshy without detrimental strain, tends to impart a perfect form to the figure, at the lower portion of the body and supports the abdomen without undue pressure on delicate organs.

COVER FOR RECEPTACLES.—A. Q. WALSH, New York, N. Y. The purpose here is to provide a cover, especially such as are adapted to contain tobacco, cigars, or cigarettes, and to so construct it that it can be simply slipped over the neck of the receptacle, closing said receptacle in practically a liquid and air tight manner and enabling the cover to be quickly and conveniently removed or placed in closing position on the receptacle.

FISH-HOOK.—H. S. WEST, Council Bluffs, Iowa. An object of this improvement is the provision of a hook with a novel and effectual weed-guard so sensitively formed as to readily yield for the hooking of a fish, but not liable to be detached from the hook-point by lateral or direct pressure when drawn through weeds or grass in water. The bait on the hook cannot be detached by a fish.

VALVE.—H. ZINS, Nicollet, Minn. The object here is to provide means whereby when the drain-pipe running from the pump-barrel to the water-tank freezes, the water which may be drawn from the well by the pump or engine after such freezing will by its pressure cause the valve constituting part of the improvement to open and allow such water to escape into the pit or other suitable place, and thereby relieve the pressure which would damage the pump, rod, engine, windmill, or other parts of the pumping system.

FISH-HOOK.—G. W. BLACKBURN, Sarasota, Fla. Mr. Blackburn's purpose in this invention is to construct a fish-hook so as to minimize the danger of losing the fish when once hooked. This end he attains by providing the hook as usually constructed with a peculiarly-arranged spur, which is preferably barbed and which is mounted on the hook so as to come into action when the fish is hooked, the spur moving toward the point of the hook proper and forming therewith a complete ring or inclosure from which it is almost impossible for the fish to become disengaged. The hook has been tested and holds the fish as securely as intended.

WOVEN FABRIC.—H. SARAFIAN, Yonkers, N. Y. It is the intention of Mr. Sarafian to produce an improved fabric which shall be distinguished by cheapness and yet present an ornamental appearance. The same is composed of a body or under portion consisting of cheap yet strong and durable material—such, for example, as cotton or jute—and a top or surface portion consisting of better and more ornamental material, such as silk or worsted. The invention is embodied in the manner of arranging threads or strands composing the ornamental surface material and the weft for tying in the same to the body or bottom portion.

DETACHABLE HANDLE FOR BROOMS, MOPS, ETC.—M. HARTMAN, Upper Sandusky, Ohio. The invention pertains to improvements in detachable handles for brooms, mops, etc.; its object being to provide improved means whereby a handle can be put on a new broom, etc., when the old one is worn out, and also to provide improved means whereby the handle can be readily taken apart and packed in small space, thereby saving in cost of transportation and shipping.

DEVICE FOR REMOVING OBSTRUCTIONS FROM BETWEEN THE TEETH.—C. F. ROTH, Chicago, Ill. Removing obstructions from between the teeth, which cannot be accomplished by the ordinary toothpick, can be done by this device. It is small, can be easily carried in the pocket, and the rubber strip can be readily removed for cleansing purposes and easily replaced, knobs at the ends of the strip operating to prevent any displacement of the latter in use.

Heating and Lighting.

ACETYLENE-GAS GENERATOR.—O. H. HASNEDER, Seaford, N. Y. A particular purpose of the inventor is to provide a readily-comprehensible safety-feed mechanism for the carbid from the hopper to the generator, controlled by one movement of the operator, and the mechanism when operated in one direction simultaneously opens access to hopper, closes the delivery-section of hopper, and establishes communication between hopper and outside atmosphere for escape of any gas which may be in hopper prior to introducing carbid therein, the feed mechanism operated one direction acting to close inlet of hopper and the vent for gases and open communication between hopper and generator.

BUNSEN BURNER.—H. F. MIELENHAUSEN, New York, N. Y. In the present patent the invention is an improvement upon a burner which is intended especially for use in connection with gas-lights which employ incandescent mantles, the object being to so construct the burner as to prevent smoking and bring about a more complete mixture between the gas and air before combustion.

Household Utilities.

FLEXIBLE ELASTIC BINDER.—C. T. WHITSETT, Indianapolis, Ind. When used as a supporting device for the covering for a bathtub the binder is extended transversely across the tub substantially midway between the ends of the latter, and the elastic strip hooks are caught over the rim of the tub at opposite points. Elasticity of the strip permits the hooks to be slipped over rim of the tub and draws hooks into close engagement with the rim, supporting the cover-sheet securely. When used upon a bundle formed by folding or rolling the sheet, one of the hooks is caught upon one corner of the bundle, while the other is caught upon the diagonally opposite corner, the corner portion of the bundle passing between bends of the two hooks.

FLAT-IRON HEATER.—J. A. LOFSTEDT, Yonkers, N. Y. The principal objects of this invention, which relates to an opening and closing heater, are to provide means for securing the proper heating of flat-irons, for preventing the waste of heat by heating them in the wrong portions, and for providing means for closing the heater when the iron is introduced and opening it when the iron is withdrawn.

Machines and Mechanical Devices.

AUTOMATIC PIANO-PLAYER. — J. B. WALKER, New York, N. Y. In rendering music it is desirable that the theme, air, melody, or other desired portions of the music be played with a different degree of intensity or expression from the accompaniment or remainder of the music, and also desirable that the operator should be able simultaneously to vary at will while he is playing the music the relative intensity of tone of theme and accompaniment. Not only should he be able to vary the relative strength of tone of theme and accompaniment, but to secure the best effects be able to vary strength of tone of the whole series of theme notes as such and of the whole series of accompaniment notes as such independently at will while playing the music, playing the accompaniment softly while playing the theme more loudly, or vice versa. In the present, which is an improvement upon one described in a former application, now pending, Mr. Walker achieves the above ends.

APPARATUS FOR THE TREATMENT OF ORES.—R. G. REILLY, Albuquerque, New Mex. An object of the invention is to provide an apparatus for treating ores in the dry way, whereby the metallic contents thereof may be reduced to the free state with a minimum expenditure of fuel and at a more rapid rate than has heretofore been possible. Further, an apparatus employed to reduce metallic constituents of ores to the free state or with equal success in desulfurizing certain ores without reducing metallic constituents to the free state.

MACHINE FOR MAKING PAPER BAGS.—B. J. JENSEN, 60 Oelenschlaegeragade, Copenhagen, Denmark. The present invention refers to improvements in machines for making paper bags and which are provided with folding-rollers and folding-knives. These suffer from the drawback that the folded sheets after being submitted to one or more foldings are apt to become shaggy, so that the two sides of the half-finished bag are no longer smooth or do not lie closely together. When such a bag is hit by the folding-knife, the fold lies aslant on the bag or the latter will when passing the rollers get creased and the finished product gets a less attractive look. This invention alleviates this drawback.

STEAM-HAMMER.—F. C. EMRICK, Bluehill, Neb. One of the leading features of the invention resides in the arrangement of the cylinder and piston-rod, the latter passing through stuffing boxes in both of the cylinder-heads, thus dispensing with the necessity for additional guides for the piston-rod. A further feature lies in the location of the valve-chest near the lower end of the cylinder and in operating the valve by means of a peculiar gear actuated from the upper end of the rod.

LOG-SAWING MACHINE.—C. E. BROWN, Stayton, Ore. Mr. Brown's invention refers to log-sawing machines, and particularly to a machine in which is combined a friction-nigger, a cant-handler, and log-deck skid-chains. He provides a construction wherein the above named parts are controlled by a single lever capable of operation in four directions, and wherein there are no steam pistons or joints to be kept in order, as in a steam-nigger, and wherein the log turns away from the nigger, preventing it from tearing off slivers, and wherein, further, the log falls upon the skids when turning, thereby avoiding jar to the carriage. Thin wide cants may be turned one at a time or several at once, a great advantage in mills having no pony-saw.

WEB-WINDING MACHINE.—E. SCHOENING, Berlin, Germany. Mr. Schoening's invention relates to winding-machines for winding paper, woven materials, and other goods in web form upon a roller, and has for its object to provide a machine of the character indicated, which will automatically and tightly wind the web in a straight and uniform manner. The invention consists of means controlled by the web for regulating the speed of the roller upon which the web is wound.

VENDING-MACHINE.—F. LYNES, Johnstown, N. Y. In this case the invention relates

particularly to improvements in ejecting devices for coin-controlled vending machines—such, for instance, as shown in a former application filed by Mr. Lynes—an object being to provide a simple device whereby a cigar or other vended article when raised to discharging position will be thrown forward upon the top of the machine-casing.

APPARATUS FOR PRINTING WARPS ON PRINTING-DRUMS.—F. SCHMIDT, 7 Edisonstrasse, Oberschöneweide, near Berlin, Germany. The present invention relates to an apparatus for printing warps on printing-drums, wherein it is essential that the adjustment of the drum is effected in such a manner that its movement is dependent upon the movement of the adjusting device for the design. In manipulation of the apparatus, the operative places an indicator upon the threads to be printed, and turns the hand-wheel till indicator points to the check to be printed. Printing of warps can be then immediately proceeded with by means of rollers or the like, as the warp-drum has been automatically adjusted at the same time as the pattern-drum.

DOUBLE PRINTING-DRUM FOR WARPS.—F. SCHMIDT, 7 Edisonstrasse, Oberschöneweide, near Berlin, Germany. The subject-matter of the present invention is a double printing drum for warps, wherein it is essential that there be two drums of different circumference which can simultaneously be printed with the same pattern, as both drums receive the same angular rotation. This uniform angular rotation is obtained by the intercalation of gearing. It is furthermore essential that the two warp-drums of different circumference be driven together with a drum containing the design or pattern, the driving thereof being effected in that driving-crowns are provided on the circumference of the drums.

Prime Movers and Their Accessories.

DRIVER-WHEEL.—E. STANCLIFF, New York, N. Y. The invention provides an attachment for a locomotive driving-wheel adapted to economize power and reduce frictional resistance. It consists essentially of an annular ring provided on its outer circumference with a flange and a tread surface, of the usual type, adapted to roll upon a rail. The driving wheel rolls on the inner circumference of the ring, the latter being formed with a groove to receive the flange of the wheel. The construction partakes of the nature of an internal gear.

BOILER.—H. L. DES ANGES, New York, N. Y. The invention relates, first, to a boiler in which water-tubes are provided around which tubes the gases of combustion circulate and through which tubes internal or fire tubes are passed, so that the heating-surface of boiler is very greatly increased; and it relates, second, to a novel manner of fitting the several tubes which holds them securely in place and at the same time allows any one of the tubes to be removed conveniently for repair and other purposes.

COMBINED THROTTLE AND GOVERNOR FOR EXPLOSION-ENGINES.—O. MINTON, New York, N. Y. The principal object of the invention is to provide between a governor of any suitable design and the gas-inlet valve of an explosion-engine a connection whose length may be varied so as to adapt the action of the governor and valve to the load carried by the engine. It has special reference to explosion-engines designed for use upon automobiles and other vehicles.

STEAM-TURBINE.—T. J. MASTERS, 29 St. Mary's street, Cardiff, Glamorgan, England. This improvement relates to a compound reversible steam-turbine or rotary engine designed to utilize both the impact or momentum and also the expansive force of the steam in such manner as to avoid back pressure and economize power in a high degree, the improved turbine or rotary engine being provided also with means whereby the speed and direction of running may be controlled more efficiently than heretofore possible in engines of the same general type.

Railways and Their Accessories.

RAILROAD SYSTEM.—C. MEHRING, Charlottesville, Va. In this instance the invention relates more particularly to single-rail car systems; and the object had in view is to simplify and improve similar railroad systems constructed as heretofore. The inventor's leading idea is the employment of novel trucks, whereby the cars are prevented derailment, and thus rendered secure for speed not safe with railroad systems as formerly constructed.

RAILROAD CROSS-TIE.—S. HOAGLAND, Astor, Fla. The object of the invention is to provide a tie which is simple and durable in construction, cheap to manufacture, and arranged to properly support and securely hold the rails in position, to avoid spreading of the rails, and to allow of conveniently placing the tie and rails in position.

REGISTER SYSTEM.—A. FEVOLA, Yonkers, N. Y. Mr. Fevola's invention relates to systems for registering the number of persons passing some predetermined point, it being especially useful in recording the number of passengers carried by such a public conveyance as a street car. Its principal objects are to provide a convenient apparatus which will operate but once for each passenger, giving a registration of the exact number using the vehicle.

VESTIBULE.—T. A. RYAN, Yonkers, N. Y. In the present patent the invention pertains to vestibules for the fronts of vehicles, it being particularly convenient for use in connection with electric cars. Its principal objects are to provide such a structure which may be readily folded out of the way when not needed and yet will furnish an effective closure when in use.

LUBRICATOR.—J. MCQUEAD, Hunt, Ill. This invention relates to lubricators, and more particularly to those adapted for use in connection with the journal boxes of cars. Its principal objects are to provide such a device which will deliver the lubricant in substantially definite quantities when the car is in motion and will stop this supply when it is at rest.

STOCK-GUARD.—H. A. MIDDAUGH, Seattle, Wash. Mr. Middaugh's invention has reference to improvements in stock-guards, the object being the provision of an absolute guard against the access of stock from the highway to the tracks of a railroad crossing the same, and one which shall be simple, cheap, and easily applied and removed.

Pertaining to Vehicles.

PNEUMATIC TIRE.—G. DEVOLL, Boston, Mass., and G. H. RISLEY, Brielle, N. J. The present invention has reference to pneumatic tires, such as are used on the wheels of vehicles; and its object is to provide a new and improved pneumatic tire arranged to prevent the rubber tube of the tire from being punctured and at the same time afford the desired elasticity.

LAMP-HOLDER.—E. E. HENRY, Georgetown, S. C. This holder is especially useful for supporting lamps on moving vehicles, such as automobiles and bicycles. The object of the invention is to produce a device of simple construction and which will afford means for supporting a lamp movably, so that the rays of light will be always projected in advance of the vehicle and in the direction in which it is advancing.

INNER TUBE AND MEANS FOR INFLATING SAME.—W. A. HOLLIS and H. S. HOLLIS, 1 Palmeira Avenue, Hove, Sussex, England. The invention relates to inner tubes for pneumatic tires and means for inflating the same. The improvement consists in the construction and arrangement of two or more inner air-tubes so that they lie around the rim of the wheel without shifting their relative positions and without bursting when the tire is inflated.

COMBINATION TRUCK AND SCALE-PLATFORM.—P. MORGAN, New Orleans, La. Under the present systems of transferring coffee-bags from the pile to the railway-cars weighing and transferring are two separate operations, each costing about three cents per bag. Mr. Morgan provides means for performing these operations at once, thus making a great saving of cost and time. The invention is capable of use in other connections. It may be used in weighing all kinds of material in sacks or other receptacles and also in bulk.

MOTOR-VEHICLE.—H. SÉCHAUD, Gentilly, Seine, France. The invention has for its object a device which permits of effecting by means of a single appliance changes of direction and velocity, throwing into and out of gear the braking, and also the regulation of motor-vehicles. The combination constituted by this device renders unnecessary all the individual parts hitherto employed for operating the different mechanism, leaves the hands of the driver at liberty, and renders it possible for complete novices to drive motor-vehicles.

WHEEL.—J. B. MCMULLEN, Howard County, Md. In the present patent the invention is an improvement in wheels, and is designed particularly for use on automobiles or other vehicles of that general character; and the inventor's object is, among others, to provide a novel construction whereby the tire may be conveniently applied and removed from the wheel by means of a removable side plate.

FOOT-WARMER.—C. H. WHITAKER, Bordentown, N. J. The foot-warmer is intended especially for use in carriages and like vehicles, and it is of that class in which a base is provided and heated by an ordinary lantern-burner mounted on the base and having heat-communicating means extending from the top of the burner to or into the base.

AXLE-LUBRICATOR.—J. ADEN, Ruralhall, N. C. In this case the improvement pertains to automatic lubricating devices for vehicle-axles of that class in which a reservoir for oil is located on the axle, just back of the axle-collar, from which oil is fed down along the spindle by distributing-grooves. The oil is uniformly fed without obstruction and in a manner to exclude the dust and remove the gummy waste matters.

Designs.

DESIGN FOR A TOILET-POWDER RECEPTACLE.—W. A. BRADLEY, New York, N. Y. This new design for a toilet-powder receptacle shows an oval contour of the box and the radial fluted ornamentation appearing at the top of the box together with the fluted and apertured cap.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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"U. S." Metal Polish. Indianapolis. Samples free.

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Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 6840.—For manufacturers of confetti-making machines.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 6841.—For manufacturers of sun motors, or machine that derives its motive power from the sun.

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Commercially pure nickel tube, manufactured by The Standard Welding Co., Cleveland, O.

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Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

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We manufacture iron and steel forgings, from twenty pounds to twenty-five tons. Crank shafts of all varieties. Erie Forge Company, Erie, Pa.

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Models, dies, boxes, metal stampings, patent articles, novelties, manufactured and sold. Printing on aluminum. U. S. Novelty Co., Lily Dale, N. Y.

Inquiry No. 6850.—For manufacturers of automatic pocket knives.

WANTED.—An engineer experienced in the design, construction and use of gasoline motors for automobiles. "Address Pope Manufacturing Company, Hartford, Conn."

Inquiry No. 6851.—For manufacturers of air pistol or rifle which can be used for small game.

WANTED.—Experienced man to take charge of Metal Department. One competent to handle large Dies, Hammers and Presses. Address Federal Casket Company, Bellaire, Ohio.

Inquiry No. 6852.—For manufacturers of duplicating apparatus.

WANTED.—Colonial silverware. Any one wishing to sell any authentic silver made in this country during the eighteenth century, please communicate with C. A. M., Box 773, New York.

Inquiry No. 6853.—For manufacturers of Virgin lace or lace bark of the tropics.

You can rent a well equipped private laboratory by day, week or month from Electrical Testing Laboratories. 548 East 80th Street, New York. Absolute privacy. Ask for terms and facilities.

Inquiry No. 6854.—Wanted, catalogue of railroad cattle guards.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, wood fiber machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 6855.—For manufacturers of pitch working machinery, namely, splitting, rounding and finishing pitch, from the cane; also machine for bleaching pitch.

Space with power, heat, light and machinery, if desired, in a large New England manufacturing concern, having more room than is necessary for their business. Address Box No. 407, Providence, R. I.

Inquiry No. 6856.—For manufacturers of overhead tracks for handling merchandise and manufactured articles in factories, such as are used in packing houses for beef.

Manufacturers of all kinds sheet metal goods. Vending, gum and chocolate, matches, cigars and cigarettes, amusement machines, made of pressed steel. Send samples. N. Y. Die and Model Works, 508 Pearl St., N. Y.

Inquiry No. 6857.—For manufacturers or parties selling a traction gear on which a 5 to 8 h. p. gasoline engine can be mounted.

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Inquiry No. 6859.—For firms' names installing crude oil gas plants.

WANTED.—A first-class Machine Shop Foreman; a man who is capable of producing work at the lowest possible cost. Must be a man of ideas and capable of hiring and handling men. Reliability first consideration. Steady position with opportunity to advance. Factory at Waterloo, Iowa. Address Manufacturer, Box 773, New York.

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Splendid opening for a high-grade mechanical engineer, who has had a broad experience in managing machine shops, the manufacture of machinery, engines and metal specialties. Applicants must be in prime of life and now employed. Preference will be given to applicants who have had modern scientific training in mechanical schools of high standing. Unqualified references will be exacted. All communications received will be regarded as strictly confidential. Address Mechanical Engineer, Box 773, New York.

Inquiry No. 6861.—For manufacturers of plucking machines (fowl).

Parties looking for factory sites should not overlook Maine. We have several towns where we are enabled to furnish factory sites on railroads and seaport harbors free of cost and abate taxes for ten years. We build homes for operatives, and let them pay for them on the rent plan at low interest. This gives the best help and practical protection against labor troubles. Maine labor will produce more per man in our small villages than in any big city in the world, and, being home owners, take more interest in their employers' welfare. We will also furnish you a Maine charter for your corporation, if you need one. Maine Realty Development Company, Bangor, Maine.

Inquiry No. 6862.—For manufacturers of machinery for turning out spoon oars and paddles.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(9632) A. G. L. asks: What is the cause of that buzzing noise when the receiver of a telephone is held to the transmitter? Is it a sign that the line is all right? How is a telephone wired that is used on the central energy system? A. When you hear a sound in the receiver of a telephone, it means that something is going on over the line. It may be someone is talking on that line, which is all right. It may be cross talk from some other line, in which case it is not all right. A central energy system is wired so that all instruments have connection with the battery to ring their bells at all times when the telephones are on the hooks. Diagrams of wiring will be furnished for any system by those who handle and sell the instruments for that system.

(9633) A. B. asks: 1. Can you tell me of a simple test to tell platinum wire? A. Platinum is characterized by its high fusing point, about 3450 deg. Fahrenheit. It cannot be melted by any temperature below that of the oxyhydrogen flame. This is the simplest test. Heating in an ordinary flame does not alter it. It is not soluble in any single acid, but is dissolved by aqua regia. 2. Is it true that there is a salt lake that has a crust of salt on the surface? If so, what is the name of it? A. There is a place called Salton in California where salt is plowed up from the surface of the shore of a lake and purified for the market. Later another crop can be harvested from the same place. Salt does not float on water. There cannot be a crust of salt over the surface of a lake. 3. Why is it that ice is a non-conductor and water is a conductor of electricity? A. Neither ice nor water when pure is a conductor of electricity. Water owes its conductivity to minute quantities of impurity in it. Ice tends to freeze itself pure from impure water. Hence ice is usually a non-conductor of electricity. 4. Can you explain to me what watt and watt-hours denote? A. A watt is the unit of electrical power. One ampere flowing at a pressure of one volt gives power of one watt. One watt working for one hour makes a watt-hour. You would find all such questions answered in Swoope's "Elementary Lessons in Electricity," which we can send for $2.

(9634) W. S. M. says: I want to put an electrical plant on my farm for lighting, water service, etc. We use compressed air for water service. Have plenty of wind. Storage batteries, from my experience, have not been satisfactory during a calm. Has any one tried compressed air as a power during a calm? Do you believe that compressed air could be used to any advantage in generating electricity? A. We know of no experiments or experience with compressed air obtained from windmills for electric lighting purposes, and would not advise its use. Storage batteries are also unsatisfactory in the hands of inexperienced persons. We would advise a gasoline or kerosene engine as the most satisfactory source of power in the majority of such cases as you have in mind.

(9635) E. G. B. says: Would it be possible to revolve an iron plate ¼ inch thick, 6 feet diameter, at the rate of 616 revolutions

per second? In other words, would it be possible to make a point on the circumference of the wheel move at the rate of 1,000 miles per hour? If not, what would be the drawback? Is air a fluid? Kindly describe a fluid. A. The centrifugal force would cause the iron plate to burst and fly in pieces at a speed far below the one which you mention. Air is a fluid. The definition of a fluid is "a substance which will readily and without perceptible friction flow in such a way as to completely fill any shaped vessel in which it may be put." Liquids and gases are fluids.

(9636) H. O. N. asks: There has been quite a bit of discussion here on this subject, and I write to you so that I may help it along. Which goes the fastest, the top of a wagon wheel or the bottom? What would be the center of it in that case? Is a wheel that is on the ground any different than a pulley in the same case? Some say that the top goes twice as fast as the axle, and that the bottom stands still. A. The discussion about the "going" of a wagon wheel turns wholly upon the use of the word "go." Define going, and all will become clear. A wheel *goes* with reference to the axle in one manner and with reference to the ground in quite another manner. Going may then be rotating or moving along. It rotates around the axle. All parts rotate alike, going around at the same speed, that is, going around in the same time, each point in its own proper circle. The whole wheel moves along with the axle over the road, at the same speed as the axle and, for that matter, at the same speed as the whole wagon moves over the road. This being settled, it remains to inquire how the parts of the wheel move with reference to a point on the ground past which the wheel may be "going." Consider a point just in front of the wheel. As it approaches this point the tire, or rather a point on the tire, comes down and rests for a moment on this point of the ground. It is not in motion on that point, if there is no slip of the wheel on the ground. This is what is meant by saying that the bottom of a wheel "stands still." It is at rest on the ground underneath the wheel for an instant. At the next instant that point of the tire begins to rise from the ground, and goes on up till it reaches the top of the wheel. The motion is a very curious motion, as you can see by marking a point on the tire of a wheel and watching its path as it comes down to the ground and rises again to the top of the wheel. It describes the curve called a "cycloid." Now when the point of the tire is at rest on the ground, the axle does not stop. It moves right on, and so does the top of the wheel. As the top of the wheel is twice as far from the ground as the axle is, it will be seen that the top of the wheel must be moving along two times as fast as the axle is moving. This can be seen in another way. Take a point on the rim which is at the same level as the axle and is behind the axle. As the wheel rolls along the road this point goes up over and comes down to the front of the wheel and to the same level as the axle. It has gained on the axle the whole diameter of the wheel. It was behind and now is in front of the axle. To do this it must have moved faster than the axle moved over the road. See if you can calculate how much faster. During the next half turn of the wheel this point drops down to the ground, rises again to the same level, and is behind the axle, by the whole diameter of the wheel. It has lost distance, and has gone over less space than the axle of the wheel went over in this half turn. See if you can calculate how much less distance it has gone over. You will find that there is just as much distance lost as there was distance gained when the point was on the upper part of the wheel. There is more of curious interest in the rotation of a wagon wheel than your questions implied. Most of the differences of opinion in discussions would be removed by a careful definition of the terms employed and a careful statement of the conditions of the case which is under discussion. There are many hot discussions in which both sides mean the same thing, but use words in different senses in expressing their meanings. Probably this is the case with your discussion.

(9637) S. T. B. asks: 1. I have read that in the secondary coils of induction coils there is sometimes a current of 30,000 volts with as low as 0.001 ampere. To me this seems to conflict with Ohm's law. To put it at a safe figure, the resistance of the secondary coil of such an instrument would not be more than 500 ohms. Then if we divide volts by ohms according to Ohm's law, we would get 60 amperes. This I can plainly see would be impossible, but please point out my mistake in reasoning. A. We do not see any reason why Ohm's law should not be applied to any case of volts and amperes to find resistance. No correct result can be impossible. It is, however, not to be supposed that the resistance in the case given is that of the secondary coil alone. It is that of the coil and the air for the spark length, whatever that was. Even when air is ionized, several inches of it has a high resistance. Nor is the resistance of a secondary coil likely to be as low as 500 ohms. No. 36 wire B. & S. has 2.4 feet per ohm, and 500 ohms would be only 1,200 feet, while a large coil giving a 12-inch spark would require at least 17 miles of such wire, with a resistance of 18,270 ohms. Spottiswoode's great coil had 280 miles of wire in its secondary; but that is more than is required for the same spark length nowadays. There are two errors in your note, one in underestimating the amount of wire used in secondaries and another in neglecting the air resistance as a factor in cutting down the amperes required in a secondary coil for a given voltage. Now again the self-induction at the moment of breaking the primary circuit causes a tremendous inductive effect upon the turns of the secondary, with the result that a tremendous voltage is produced in the secondary coil. This rises enormously above 30,000 volts when the spark distance is large. A table recently issued shows that 20,000 volts are required to throw a spark 1 inch between sharp points in the air; while to throw a spark 15 inches, 150,000 volts are required. Now coils have been made to throw 45 inches. How many volts do they represent? We do not know; 30,000 volts are a very little thing. And what is the voltage for a lightning spark a mile or two long? 2. How does magnetism interfere with the working of a watch? A. The magnetism of the steel parts of a watch affects the motion of the hairspring and balance wheel when that is of steel or has steel balancing parts upon it. 3. Have diamonds ever been produced artificially? A. Diamonds have been made artificially by Moissan in his electric furnace experiments, and they have been found in meteorites. See Moissan's "Electric Furnace," page 77.

(9638) W. R. M. asks: I am puzzled over a problem in electricity. Here it is: What number of volts and amperes will light a 12-watt electric lamp?

1 volt	× 12	amperes	= 12 watts
2 volts	× 6	amperes	= 12 watts
3 volts	× 4	amperes	= 12 watts
4 volts	× 3	amperes	= 12 watts
6 volts	× 2	amperes	= 12 watts
12 volts	× 1	amperes	= 12 watts
24 volts	× ½	ampere	= 12 watts

You see the products are all the same from the multiplication of the volts × amperes. Please explain about the lamp and voltage and amperage. A. We do not see any puzzle about your problem. You show that there can be seven different ways of dividing the volts and amperes so that the lamp will have 12 watts. There is no puzzle about that. It is quite true. The only question is, which would be the better way to divide the volts and the amperes. We would decide that to be either the 6 volts and 2 amperes, or the 12 volts and 1 ampere, or 24 volts and ½ ampere. The higher the voltage the smaller the wire necessary to carry the current without overheating the wire, and so the cheaper the wiring will be.

(9639) C. B. R. writes: What controls the circulation of elaborated sap of trees? Why does, or does, it rise in the spring? Or where does it come from? At what time each month can a bush having sugar in its roots be cut so that it will sprout and grow? At what time each month will it die if cut? What stops the circulation or keeps it back from the roots at times? Why would freezing the ground make a free flow of sap, and no frost a moderate flow? Why when a board or straw is laid on the ground at certain times, it will settle down, at other times it will rise? A. The rise of water in trees from the root tips to outermost twig is a strange thing, and its mechanics is not even yet clear. Capillarity plays a part, as also does osmotic pressure. The power of living protoplasm to imbibe water was once thought to explain it. Again, others have thought that the evaporation from the leaf surfaces causes the water below to rise as if drawn up by pulling on the end of a filament of water. All these and perhaps other and undiscovered causes may be at work to raise the water sometimes hundreds of feet. The water rises most easily in the new wood, and this is formed in the early summer or late spring. We do not believe that the time of the month has anything to do with the sprouting of seeds or the growing of sprouts. This is an old superstition connected with the moon, which dies hard. If a twig is cut off, the power of growth in the tree usually is sufficient in the early part of the year to produce other shoots to take its place in the support of the life of the tree. Late in the season these sprouts do not so readily appear. There are always buds in the bark which will grow if moisture is supplied to them. They may stay years without starting, and wounds given to the tree may then make them start to grow. Sap circulates freely till the ring of wood and new bark is formed and the walls of the cells have thickened so that water cannot easily pass through these walls. The flow is not then much. The season of growth is over for that year. The flow of sap out of a tree in which a hole has been made, as in the sugar maple, in early spring is due not to the freezing of the ground, as most suppose, but to the expansion of the water by the warmth of the sun during the day. The tree is gorged with sap, which is ready for the production of wood for the spring. The nights are cold, below the freezing point, the day is warm; the large difference of temperature expands the sap, and forces some of it out of any hole in its course up the tree. When this large fluctuation of temperature from the day to the night and back again ceases, the tree also ceases to give sap for sugar. We do not understand the question of the board laid on the ground and sometimes sinking and at others rising. We never saw or heard of that before.

NEW BOOKS, ETC.

New York Air Brake Catechism. By Robert H. Blackall. New York: The Norman W. Henley Publishing Company, 1904. 12mo.; pp. 250. Price, $1.25.

This book is intended principally for the railroad brakeman and locomotive engineer. It is written very clearly and concisely, and is illustrated with numerous diagrams that show all the essential parts of the braking apparatus of a modern train. The book contains a line cut of the complete New York Automatic Air-Brake as applied to locomotive, tender, and passenger car. This cut shows at a glance all the different hose and valve connections, and the valves and other apparatus are shown in section. The volume forms an indispensable handbook for all railroad men.

Crushed Stone and Its Uses. By W. J. Jackman. Chicago: Producers Supply Company, 1904. 8vo.; pp. 110.

This little volume, which is distributed gratuitously by the publishers, contains practical information on the various uses of crushed stone and concrete made with it. The articles in the book are by prominent engineering experts, and from these articles the main points deduced are that concrete made with crushed limestone, screenings, and good cement is the ideal material for every form of construction in which economy and permanency are desired; that this kind of concrete is the only building material which may be considered completely fireproof; that the substitution of limestone screenings for sand results in a stronger and more durable and homogeneous concrete product, together with less expense; and that this item of cheapness and first cost, besides the durability of the material, insures a marked economy in subsequent expenditures for maintenance. Besides the articles on the uses of concrete for various purposes, such as the building of roadways, bridges, seawalls, sewers, tunnels, stairways, and outside building construction, the book contains tests showing the tensile strength, etc., of different mixtures of the substance.

The Theory of the Lead Accumulator (Storage Battery). By Dr. Friedrich Dolezalek. New York: John Wiley & Sons, 1904. 12mo.; pp. 241; 30 figures. Price, $2.50.

This work, which has been translated from the German by Carl L. von Ende, Ph.D., of Goettingen, Instructor in Chemistry of the State University of Iowa, goes into the chemical properties of the lead accumulator in a very thorough manner. The author first discusses the various theories—such as the chemical, thermodynamical, and osmotic—of the origin of current. The variation of electromotive force and of the electrode potential with acid concentration is also discussed, and chapters are devoted besides to the temperature coefficient, the influence of external pressure, the internal resistance, and the methods of measurement of the same. The changes in the cells during formation, the variations in capacity, and the changes in the cell during use, as well as its behavior during charging and discharging, its reversibility, and influence of external pressure, are all gone into with great minuteness. The book will be found most valuable to the storage battery manufacturer and chemist.

A Textbook on Physics. Heat. By J. H. Poynting, Sc.D., F.R.S., and J. J. Thomson, M.A., F.R.S., Hon.Sc.D. Philadelphia: J. B. Lippincott Company, 1904. 8vo.; pp. 354; 193 illustrations. Price, $4.25.

This is the third volume of an excellent series. The first two volumes dealt with the properties of matter and sound, and the present one deals with heat. The book is intended chiefly for the use of students who lay most stress on the experimental part of physics. Only the phenomena which are of special importance are described, and the mathematical methods used are very elementary. The book deals with all the familiar manifestations of heat, such as conductivity, heat circulation and convection in liquids and gases, the expansion of solids, liquids, and gases with the rise of temperature, the forms of energy with its conservation, the mechanical equivalent of heat, the change of state on account of heat, radiation and temperature, and the thermodynamics of the former. The book is well illustrated with numerous diagrams, and is one of the best experimental textbooks on this subject which has come to hand.

Model Library. Vol. 1. By Norman H. Schneider. New York: Spon & Chamberlain, 1905. 12mo.; pp. 383. Price, $1.

This book is a practical work for the use of the amateur electrician. It is made up of four separate pamphlets dealing with the Study of Electricity for Beginners; Electric Bells, Annunciators, and Burglar Alarms, and How to Install Them; How to Make and Use Dry Batteries; and Electric Circuits and Diagrams. The book is very simple in character, yet it goes into all the essential details of the subjects treated. In the part on Electric Bells full directions are given, which will enable the amateur to install such bells and annunciators of various kinds. The part on Dry Batteries gives full directions for making not only the usual dry battery with a carbon core, but also a lead-zinc dry cell, which furnishes two volts and can be used chiefly for experimental purposes. The part on Electrical Circuits and Diagrams is made up almost entirely of diagrams of wiring for various purposes, such as bells, automobiles, dynamos, gas lighting, motors, storage batteries, street railways, telephones, telegraphs, wireless telegraphy, and testing. The book will be found a useful addition to the library of any amateur electrician.

A Textbook on Steam and Steam Engines, Including Turbines and Boilers. By Andrew Jamieson, M.Inst. C.E. Philadelphia: J. B. Lippincott Company, 1904. 8vo.; pp. 780; numerous illustrations and diagrams. Price, $3.

The present, or fourteenth, edition of this well-known work has been brought thoroughly up to date by the addition of two lectures on steam turbines for land and marine purposes, and the rewriting of several others. The latest kinds of pyrometers and calorimeters, with their applications, have been dealt with, special attention being given to the fundamental principles of heat and thermo-dynamics. Both ideal and actual conditions of wet, dry, and superheated steam have received particular attention. The latest form of indicator, together with numerous diagrams of simple, compound, triple, and quadruple-expansion reciprocating engines, have been illustrated and discussed. The connection between work done in the cylinder and energy given out by the crankshaft has been explained, step by step, and has been illustrated with carefully calculated and plotted crank-effort diagrams for a recent quadruple-expansion, five-crank engine. Other lectures are devoted to the various forms of Corliss engine valve-gear; to high-speed, quick-revolution, compound and triple-expansion, electric light and power engines; and to the best automatic systems of lubrication. The most economical quadruple-expansion marine engines, together with their boilers, and appliances for induced draft, superheating, jacketing, and draining—which led to their unsurpassed economy of less than a pound of coal per indicated horse-power hour—will be found fully illustrated. The cause of and remedies for corrosion in marine condensers and boilers have been thoroughly discussed.

A series of questions at the end of each lecture makes the book valuable to the student for review purposes.

Solar Heat. Its Practical Applications. By Charles Henry Pope, A.B. Boston: Charles H. Pope, 1903. 16mo.; pp. 160. Price, $1.

This is an interesting little volume on solar heat by the author of "Solar Engineery." It gives full details of the various sun motors that have been constructed, and the amount of power that has been obtained from them. It is a popular book of interest to all, and we heartily recommend it to our readers.

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"Royal Pilsen," for beer, Abner-Drury Brewing Co. ... 12,119
"Southern Queen," for baking powder, United States Printing Co. ... 12,111

PRINTS.

"Buf-Ce-Co Horse Feed versus Oats," for horse feed, T. F. Wales ... 1,307
"Every Knock's a Boost," for scales, National Pitless Scale Co. ... 1,309
"Ice Cream Soda," for ice-cream soda, Bemis Bro. Bag Co. ... 1,306
"Pick Up Your Bed and Walk," for beds, Telescope Cot Bed Co. ... 1,308
"Swift's Return Tube Portable Boiler," for boilers, E. H. Swift ... 1,305
"We'll Keep You Running," for vehicles and wagons, Mitchell-Hunt Co. ... 1,310

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., 361 Broadway, New York.